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ABSTRACT

The study examined the likely response of nonresident enrollments to a lowering of nonresident tuition rates in South Dakota public institutions of higher education; the cost of educating additional nonresident students; and other economic benefits to the state of increased enrollment of nonresident students at state universities. Nonresident enrollment trends (1972-1985) are summarized textually and graphically for: the University of South Dakota, Black Hills State College, Dakota State College, Northern State College, South Dakota School of Mines and Technology, and South Dakota State University. The demand model is then applied in terms of the price-enrollment relationship, the econometric demand model, price elasticity of demand, and marginal revenue. Finally, the least-squares-dummy-variable method of estimating the coefficients of the model is applied to the pooled sample for students from Iowa, Minnesota, North Dakota, Nebraska, Wyoming, and all other states and foreign countries. The data were also examined in terms of the cost model, an econometric estimation of the cost function, demand and cost together, and community effects of increased enrollment. It is concluded that a reduction in nonresident tuition rate would significantly increase enrollment but that increased costs would be greater than increased revenues. Inexpensive strategies for increasing nonresident enrollment are outlined. Data is displayed in 8 tables and 46 figures; 9 references are provided. (DB)

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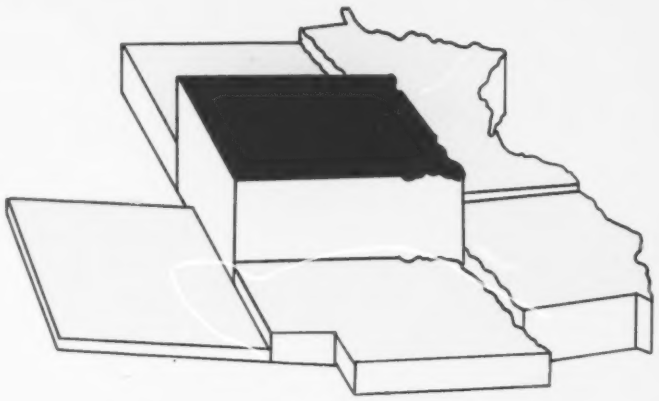

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A STUDY OF THE ECONOMIC IMPACT OF VARIATION IN THE NONRESIDENT TUITION RATE AT PUBLIC INSTITUTIONS OF HIGHER EDUCATION IN SOUTH DAKOTA

Bulletin Number One Hundred Thirty-Two

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A STUDY OF THE ECONOMIC IMPACT OF VARIATION IN THE NONRESIDENT TUITION RATE AT PUBLIC INSTITUTIONS OF HIGHER EDUCATION IN SOUTH DAKOTA

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of the State of South Dakota

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A STUDY OF THE ECONOMIC IMPACT OF VARIATION IN THE NONRESIDENT TUITION RATE AT PUBLIC INSTITUTIONS OF HIGHER EDUCATION IN SOUTH DAKOTA

By

Ralph J. Brown and Dennis A. Johnson*

I. INTRODUCTION

Tuition policy regarding nonresident students at public institutions of higher education has been a subject of considerable controversy. It has been argued in some quarters that nonresident tuition rates should be lowered to encourage nonresident enrollment. Proponents of this proposal often argue that geographic and economic diversity improve the educational environment of the college.[1] Another argument for lowering nonresident tuition rates is that in a time of declining enrollments, efficient utilization of fixed capacity and the viability of certain programs requires policies to maintain minimum enrollments. Finally, it has been argued that these students contribute financially to the state's economy through their spending.

---

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[1] James N. Morgan, "Tuition Policy and the Interstate Migration of College Students," Research in Higher Education, Vol. 19, No. 2, 1983, p. 184; Robert F. Carbone, "Future of the Low-Tuition System," Educational Record, Fall 1983, p. 267; and David B. Palley, "Resolving the Nonresident Student Problem," Journal of Higher Education, Vol. XLVII, No. 1, February 1976, pp. 18.

Opponents of lower nonresident tuition rates argue that present rates represent a subsidy to nonresident students and that the first obligation of the state is to fund the educational needs of its own residents.[2] In their view the proposed benefits of increased diversity are outweighed by the economic considerations of the nonresident tuition level relative to the cost of educating that student.

Obviously, there are important economic and noneconomic considerations in the establishment of a proper policy regarding the setting of tuition rates for nonresident students. The purpose of this study is to attempt to provide answers to some of the more important economic questions regarding the setting of nonresident tuition rates by South Dakota public institutions of higher education. This study was designed to explore and attempt to find answers to the following economic questions.

1. What is the likely response in terms of nonresident undergraduate enrollments to a lowering of nonresident tuition rates in South Dakota public institutions of higher education? Would the increased revenue from increased enrollments be sufficient to offset the lower revenues due to reduction in nonresident tuition charges?
2. What is the cost of educating additional nonresident students in South Dakota public institutions of higher education and is this cost more or less than the

---

[2] See Morgan, p. 184 and Palley, pp. 3-4.

additional revenue generated by reducing the tuition rate to attract additional students?

3. What are the other economic benefits to the state's economy in terms of increased spending and tax revenues to be derived from a higher enrollment of nonresident students?

This report is organized as follows: Section II will review the historical pattern of nonresident enrollment at public institutions of higher education in South Dakota, Sections III and IV will review the demand model used to estimate the sensitivity of nonresident enrollment to tuition rates, Sections V and VI will review the cost model and the cost estimates, and Section VII will bring the demand and cost estimates together. Section VIII will analyze the community impacts of increased enrollment and Section IX will summarize the results and findings of this study.

II. NONRESIDENT ENROLLMENT TRENDS BY SCHOOL

A. University of South Dakota

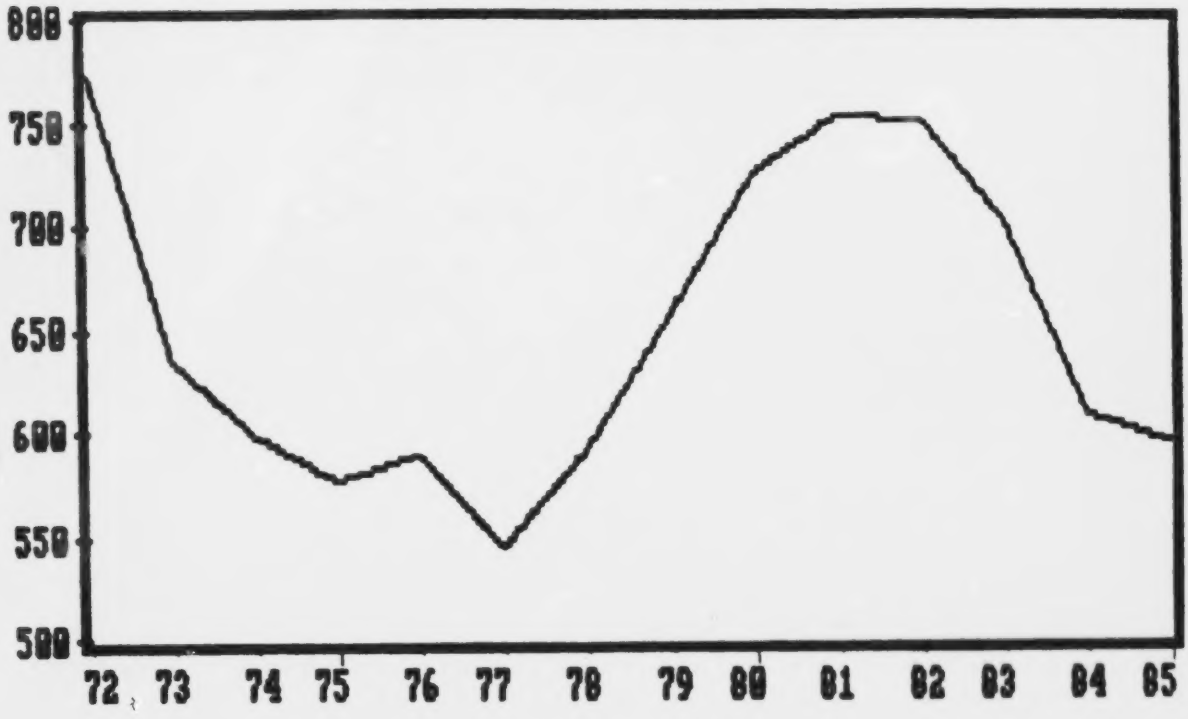
Nonresident enrollment at the University of South Dakota (USD) has come mainly from the surrounding states. Of these states, nearby Iowa and Nebraska have provided the bulk of students attending USD. In 1985, 595 students came from Iowa, while 143 came from Nebraska. In addition, enrollment from

Minnesota has increased over the last ten years, bringing the total number of students from this state to 97 in 1985. Enrollment from the remaining surrounding states of North Dakota and Wyoming continues to be less than 10 students. Still, nonresident enrollment has not been confined to the five neighboring states. In 1985, 118 students came either from one of the other 44 states or a foreign country.

Figure 1 shows the pattern of Iowa enrollment at USD between 1971 and 1985. While the largest percentage of nonresident students still comes from Iowa, enrollment has followed a downward trend since 1980. However, as the graph well indicates, such declines have not been uncommon over the last 15 years. Iowa enrollment appears to have followed a cyclical pattern, falling from 830 in 1971 to 544 by 1977, rising to 754 in 1980, and again falling to 595 in 1985. In the next section we will examine the relationship between these swings in enrollment from Iowa and changes in tuition rates in both states.

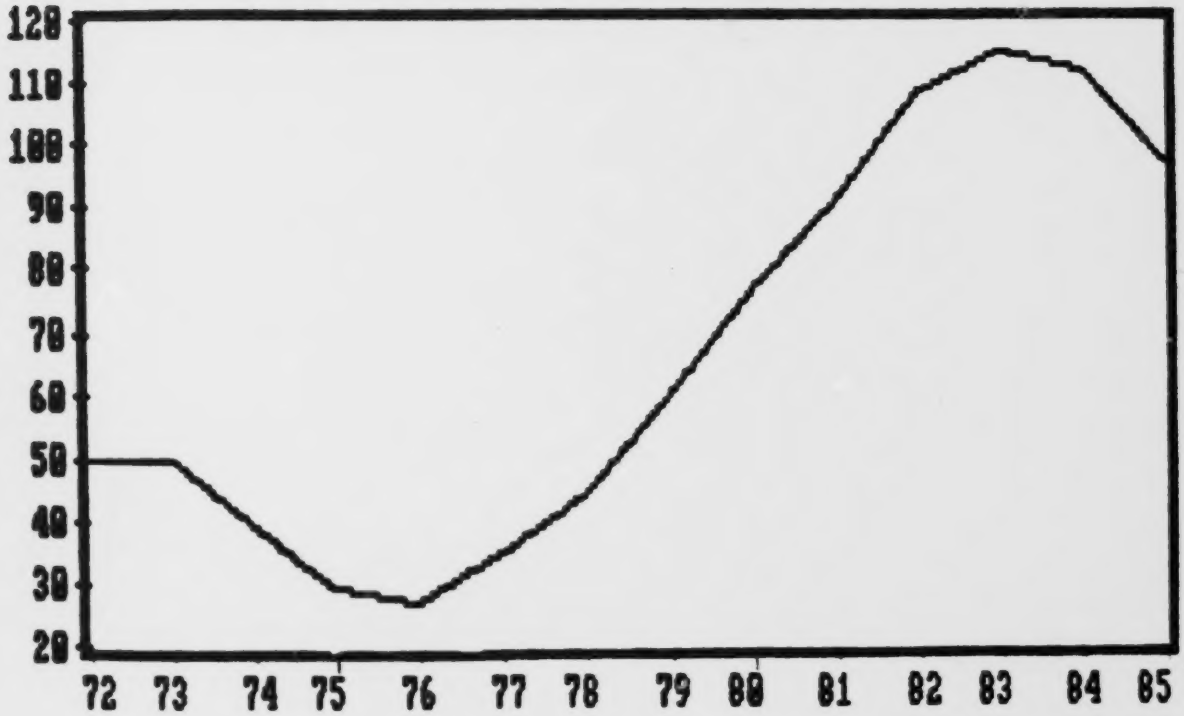
As is the case with Iowa, Minnesota enrollment at USD has declined in recent years from 115 in 1983 to 97 in 1985. Figure 2 shows that prior to 1983, enrollment steadily increased from a low of 27 in 1976. The tuition reciprocity agreement in 1978 had a very significant impact on enrollment from Minnesota. Nebraska enrollment at the University in 1985, shown in Figure 3, which at 143 students was at its highest during the 15 year observation period. After leveling off between 1981 and 1983, enrollment appears to be resuming the upward trend it began in 1978, when

FIGURE 1: IOWA ENROLLMENT AT USD



enrollment bottomed out at 77. The period between 1971 and 1985 has seen a clear downward trend in enrollment from students living outside of the five surrounding states. Figure 4 shows that nonresident enrollment at USD from outside the region and from foreign countries in 1985 was 118--the lowest in well over 15 years. This is in contrast to enrollment figures in the early 1970's, such as 211 in 1974 and 207 in 1972. Of those students enrolled at USD in 1985, 13 came from Illinois and 19 were foreign students. Enrollment from each of these areas was up slightly from 1984.

FIGURE 2: MINNESOTA ENROLLMENT AT USD

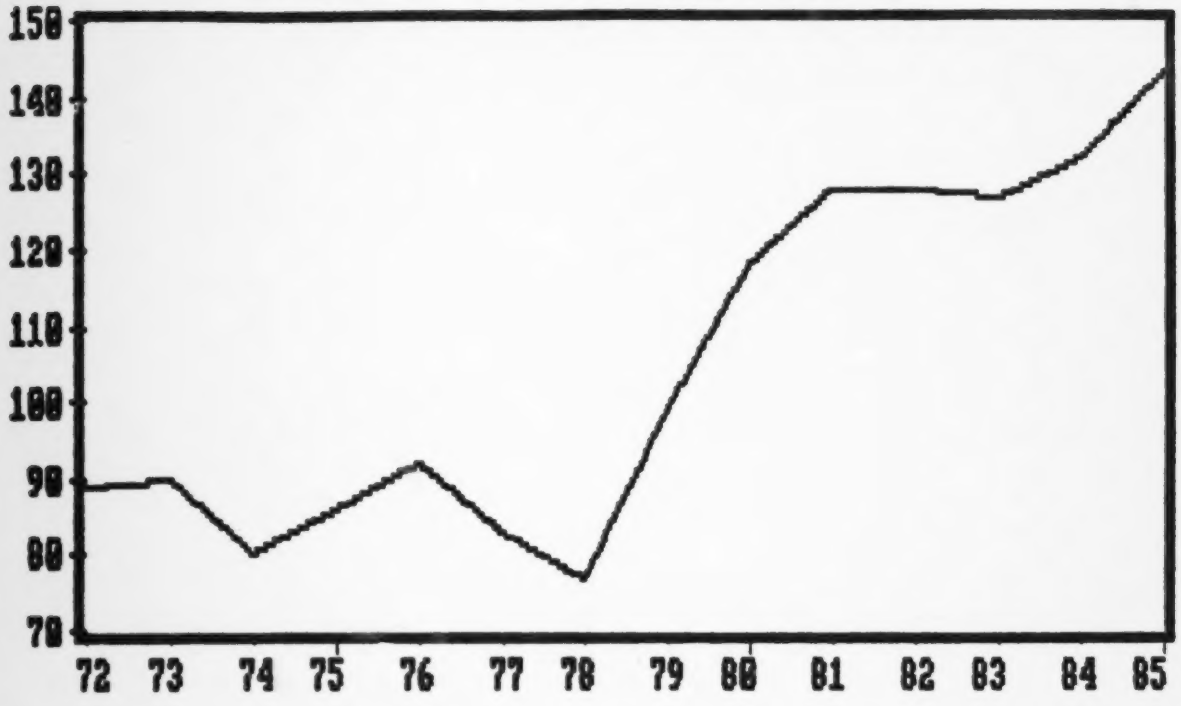


B. Black Hills State College

By far the largest number of nonresident students at Black Hills State College (BHSC) have come from Wyoming. In 1985, 147 Wyoming students were enrolled at BHSC. This compares with only 19 from North Dakota, 14 from Nebraska, 9 from Minnesota, and 6 from Iowa. On the other hand, many students have come from areas outside the surrounding states. Ninety-three such nonresident students came to BHSC in 1985.

As shown in Figure 5, enrollment at BHSC from Wyoming has jumped considerably since 1981. Before that time, enrollment remained relatively constant, climbing as high as 95 in 1971 and

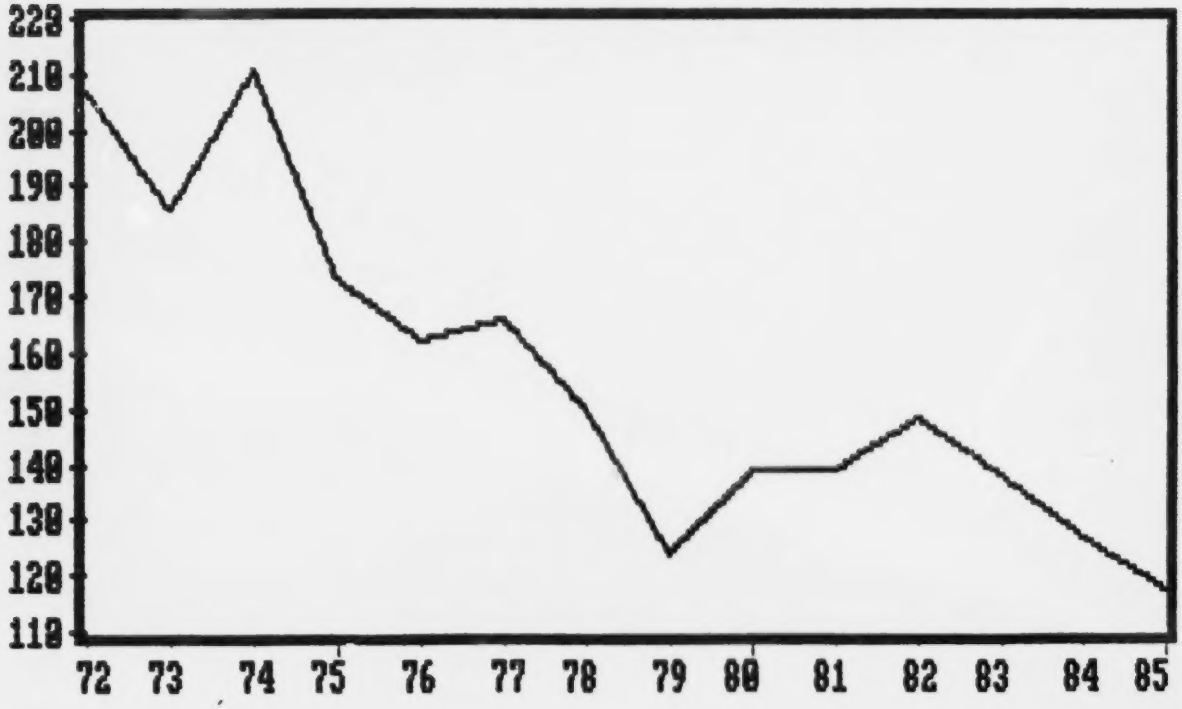
FIGURE 3: NEBRASKA ENROLLMENT AT USD



falling as low as 72 in 1979 and 1981. However, beginning in 1983 enrollment from Wyoming rose to 126 and by 1985 enrollment was at its highest level of 147 students. Several factors probably account for this rise. Recruitment efforts in Wyoming by BHSC representatives have increased significantly and beginning in 1985 articulation agreements between Wyoming community colleges and BHSC were worked out which allowed Wyoming students to attend BHSC with minimal loss of credits. Consequently, an increasing number of Wyoming students have begun pouring into BHSC.

Of all the state colleges in South Dakota, BHSC appears to have attracted the most students from outside the immediate region surrounding South Dakota, although as Figure 6 indicates,

FIGURE 4: NON-REGIONAL ENROLLMENT AT USD

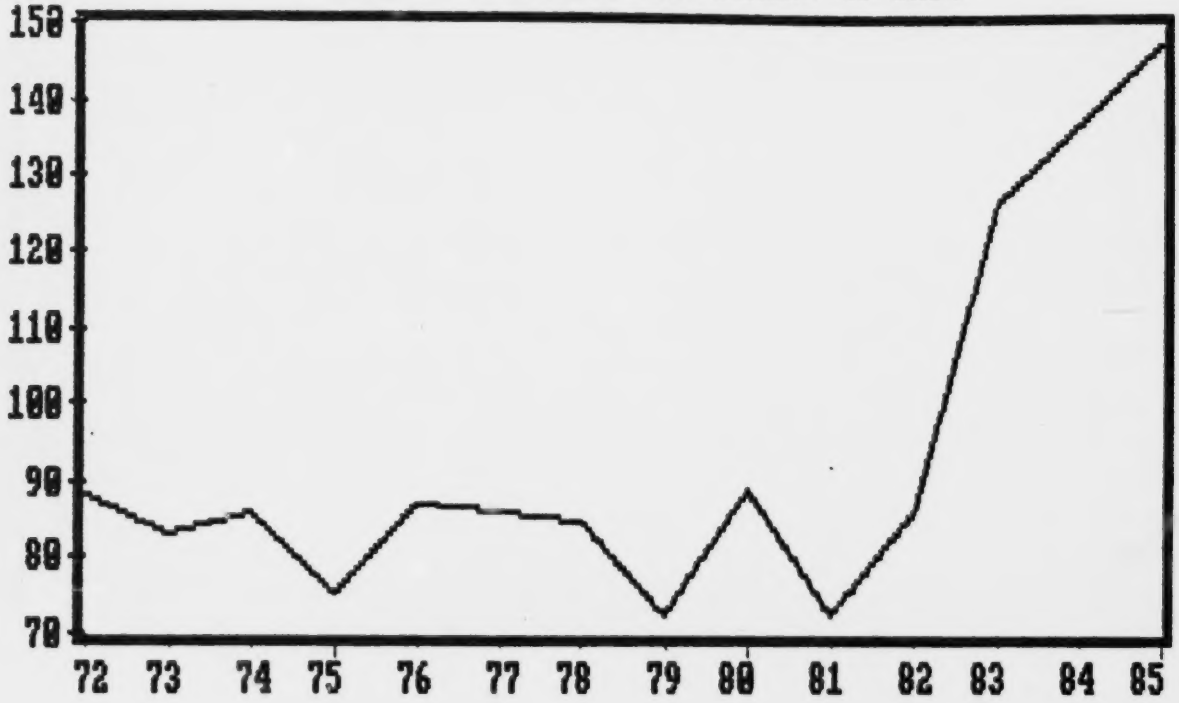


enrollment has not followed any set pattern. In 1985, 15 students came from Montana, and 11 students came from foreign countries. During the period between 1971 and 1985 a notable number of students also came from Colorado.

C. Dakota State College

As shown in Figure 7, enrollment from Iowa, Minnesota, and all other states showed little consistency over the 1972-1985 time period. Enrollment from Iowa showed a downward trend for most of the period, while Minnesota enrollment increased sharply during the 1978-1985 period of the reciprocity agreement.

FIGURE 5: WYOMING ENROLLMENT AT BHSC

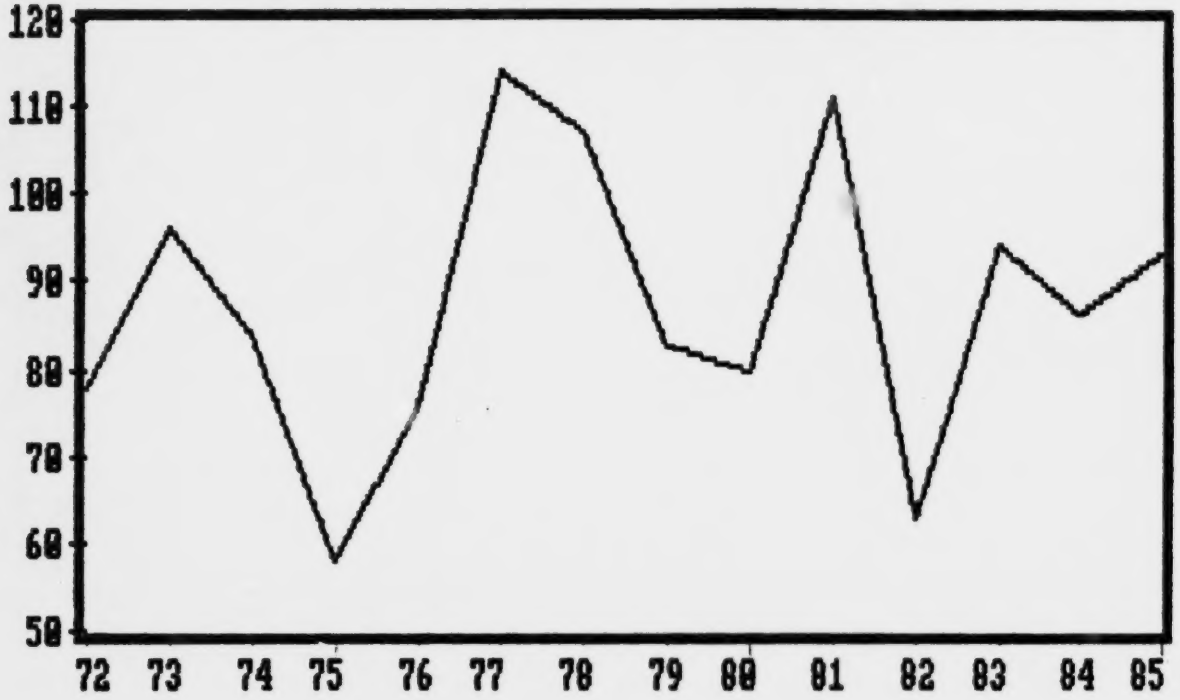


By 1985, the majority of Dakota State College's (DSC) nonresident students came from Minnesota (24 students in 1985) and areas outside the region (19 students in 1985). The latter can be best attributed to an increasing number of foreign students at the school. Fourteen foreign students were enrolled at DSC in 1984. Only 11 students came from Iowa in 1985---considerably less than 42 in 1971 and 36 in 1972. Less than 5 students came from North Dakota, Nebraska, and Wyoming.

D. Northern State College

Minnesota and North Dakota are the largest contributors to

FIGURE 6: NON-REGIONAL ENROLLMENT AT BHSC



nonresident enrollment at Northern State College (NSC) with 37 and 33 students, respectively, in 1985. Iowa, Nebraska, and Wyoming each provided 3, 2, and 0 students, while students from outside the region numbered 38 in 1985.

Since 1971, the most dramatic increase in nonresidents has come from Minnesota. Enrollment from Minnesota is shown in Figure 8. Throughout much of the 1970's enrollment figures were fairly constant, varying between 5 and 6 students with the exception of 14 in 1971 and 8 in 1974. The 1978 Minnesota-South Dakota tuition reciprocity agreement appears to have had a major impact on NSC enrollment from Minnesota, especially in the early 1980's. In the two year period between 1980 and 1982, enrollment jumped

from 17 to 54. While enrollment has steadily declined since 1982, Minnesota still provides NSC with many of its nonresident students.

FIGURE 7: ENROLLMENT AT DSC FROM MINNESOTA, IOWA, ALL OTHER STATES, AND FOREIGN COUNTRIES

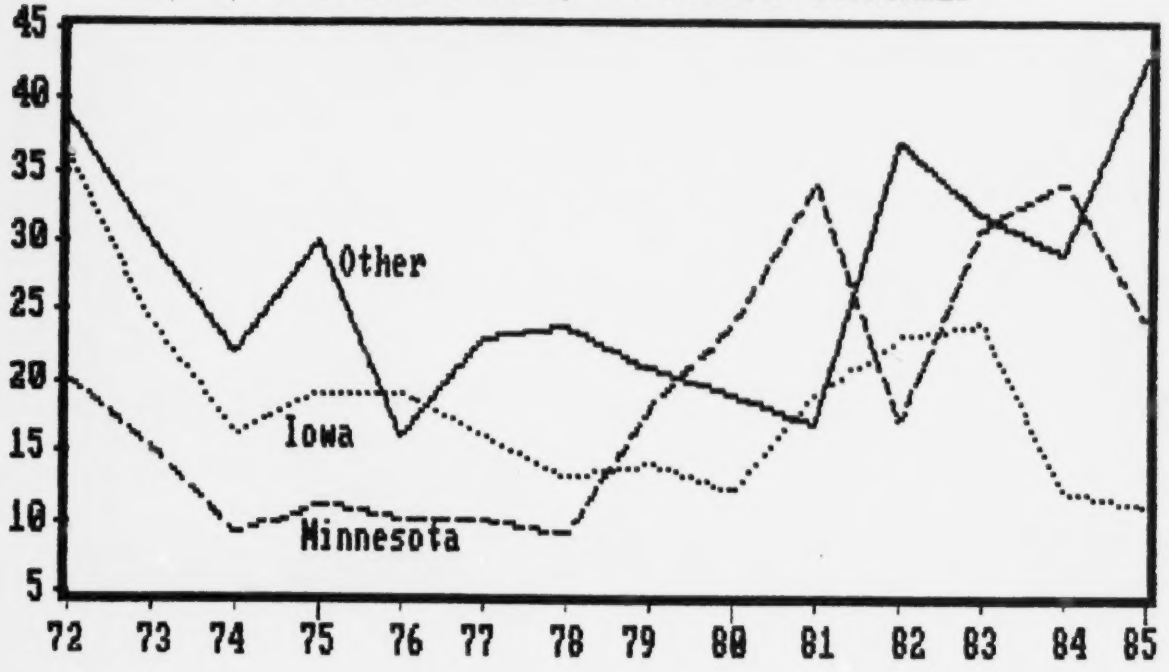


Figure 9 shows North Dakota enrollment patterns at NSC over approximately the last 15 years. Despite the fact that North Dakota has consistently been a significant contributor to NSC's student body, enrollment has followed a cyclical pattern, going as high as 46 in 1971 and as low as 18 in 1977. Enrollment actually leveled off at about 22 between 1982 and 1984 before it took its largest jump in at least 15 years to 33 in 1985.

FIGURE 8: MINNESOTA ENROLLMENT AT NSC

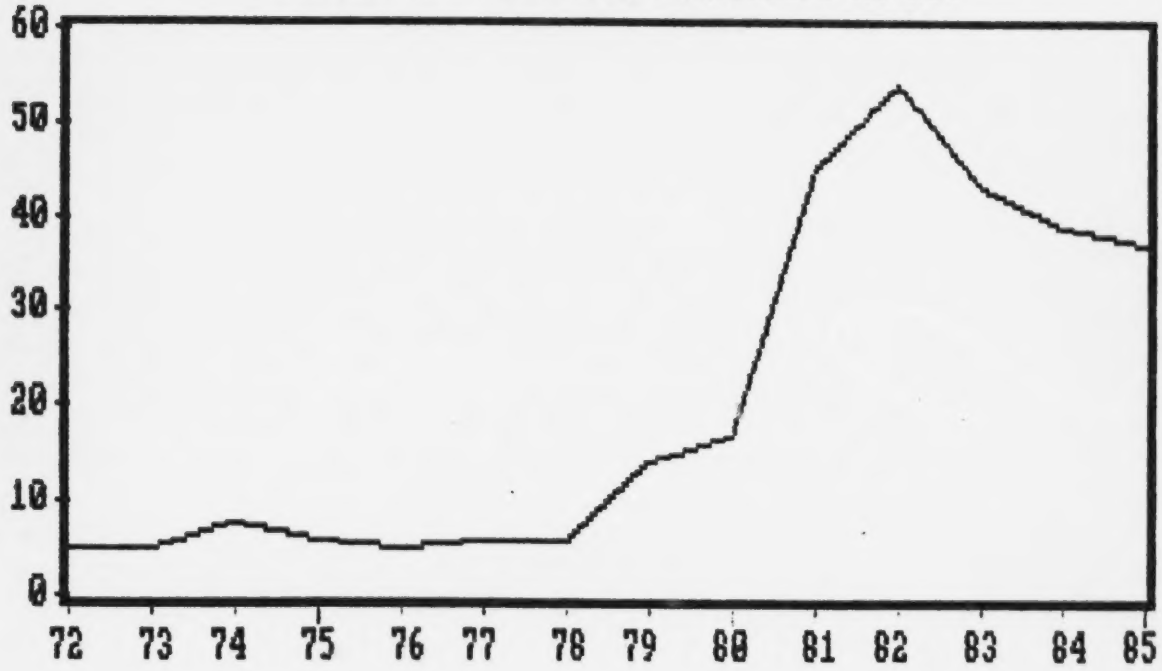


Figure 10 also shows that nonresident enrollment from areas outside the surrounding states has been significant, although, like the other state colleges, it has not followed any consistent pattern. In recent years, NSC has attracted students from several states outside the region, including Illinois, Wisconsin, and Florida. Ten foreign students enrolled at NSC in 1985.

E. South Dakota School of Mines and Technology

South Dakota School of Mines & Technology (SDM&T) has seen a tremendous rise in nonresident enrollment since 1971. Students from Nebraska, Minnesota, Wyoming, North Dakota, and other areas

around the country have come to the school in ever-increasing numbers. An exception to this has been Iowa, which has provided less than 10 students each year, probably because nearby Iowa State University offers similar engineering programs.

FIGURE 9: NORTH DAKOTA ENROLLMENT AT NSC

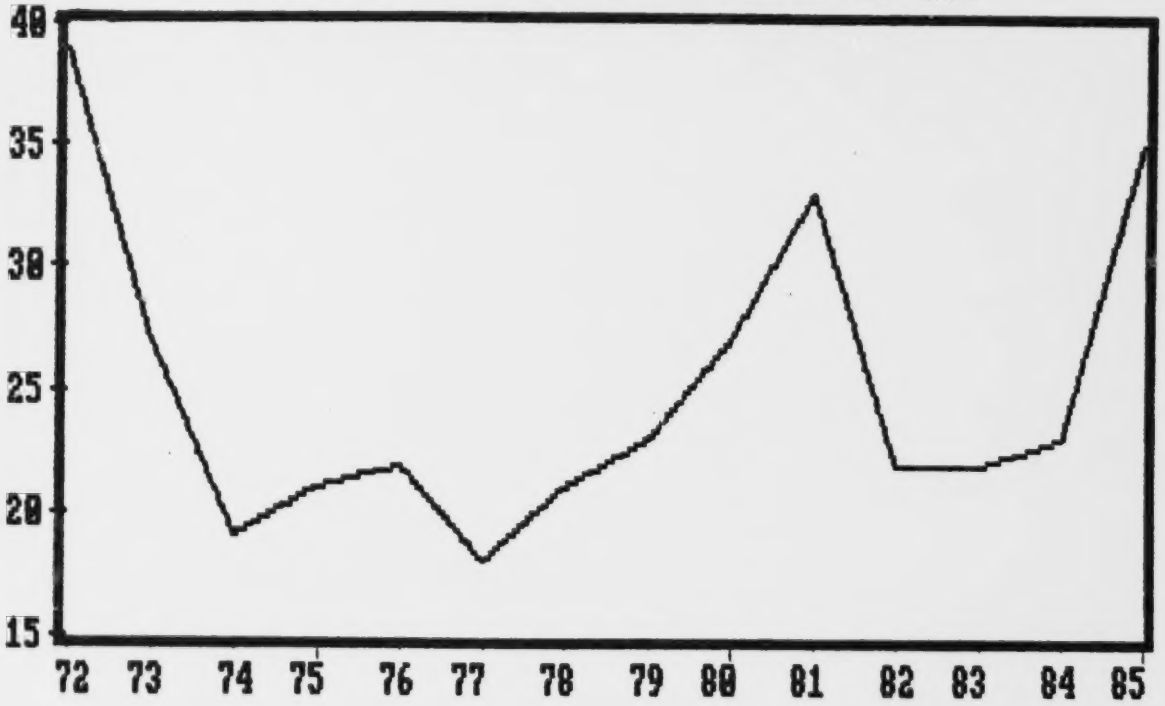
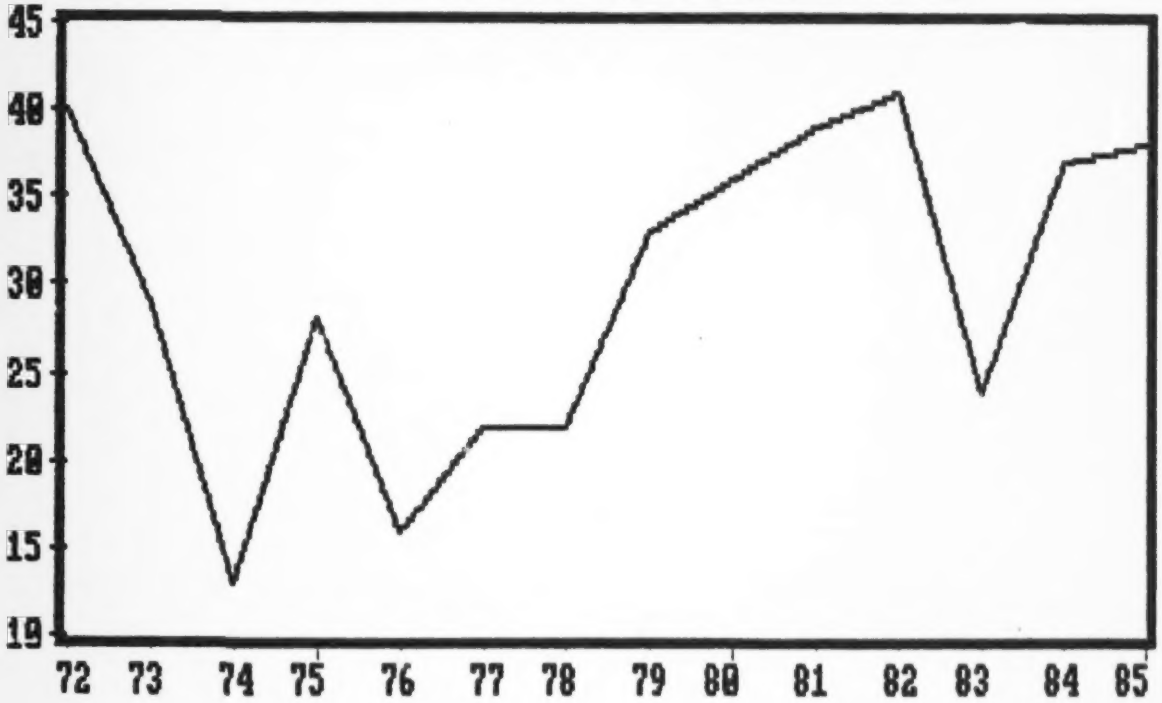


Figure 11 illustrates the trends in non-regional enrollment. In 1985, 177 students came from areas outside the region, 81 came from Nebraska, 61 came from Minnesota, 35 came from Wyoming, and 22 came from North Dakota. In recent years, SDM&T has boasted a more geographically diverse student body than any of the other colleges and universities in South Dakota. For example, during the 1984-85 academic year, the school enrolled 10 students from Pennsylvania, 11 from New York, 12 from Colorado, 13 from Ohio,

17 from Illinois, as well as 82 foreign students. While the total number of nonregional students dropped from 220 in 1984 to 177 in 1985, SDM&T still has considerably more nonregional students than it did in the early 1970's when enrollment was as low as 94 in 1973.

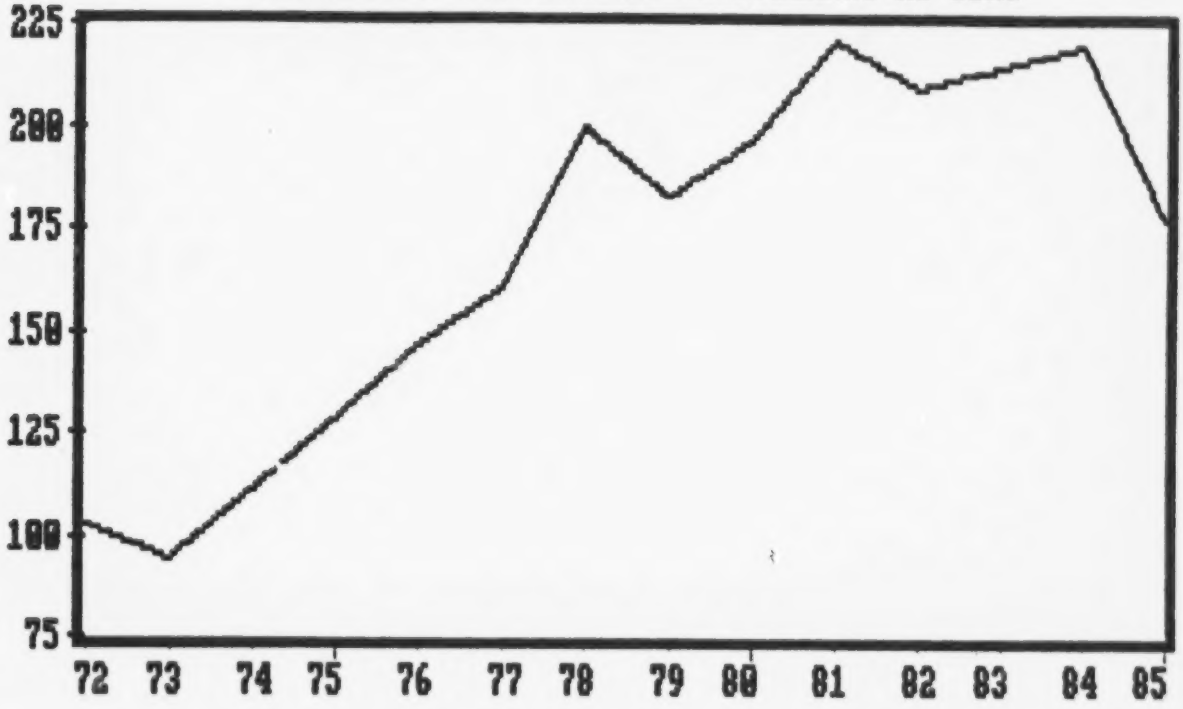
FIGURE 10: NON-REGIONAL ENROLLMENT AT NSC



Since about 1981, most students from the immediate region have come from Nebraska. Enrollment from Nebraska, shown in Figure 12, with some exceptions, has steadily increased since 1979, when only 26 Nebraskans came to the school. Throughout much of the 1970's, Nebraska enrollment was fairly constant, rising as high as 26 in 1976 and 1979 and dipping to 17 in 1975. Enrollment in 1985 declined for the first time in 8 years.

As shown in Figure 13, enrollment from Minnesota has also increased considerably since the late 1970's. The 1978 Minnesota-South Dakota reciprocity agreement again appears to have had an

FIGURE 11: NON-REGIONAL ENROLLMENT AT SDMT

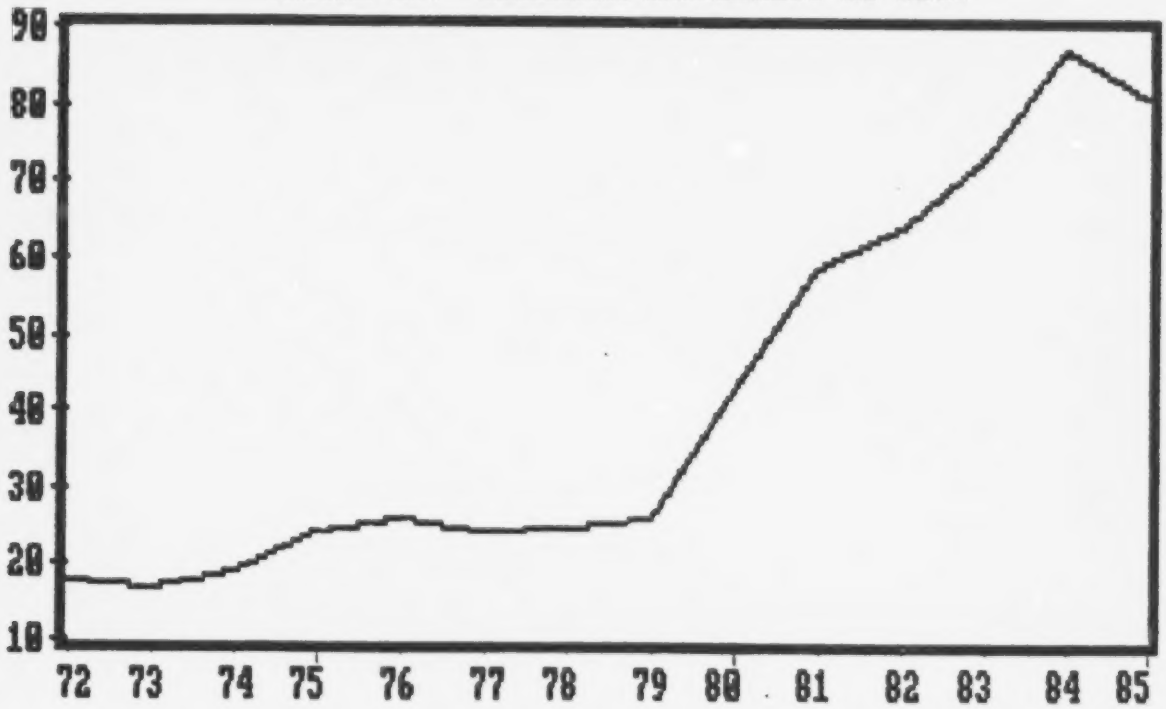


immediate impact, pushing enrollment to a high of 84 in 1983. Since then, however, enrollment as steadily declined.

Both Wyoming and North Dakota have provided for an overall increase in students since 1971. Wyoming enrollment rose throughout much of the 1970's, but since 1979, enrollment has varied from year to year, peaking at 52 in 1981 and holding steady at 33 between 1983 and 1984. Enrollment in 1985 rose slightly. Between 1980 and 1984, North Dakota enrollment

increased from 14 to 31. North Dakota enrollment took its sharpest decline in 9 years in 1985.

FIGURE 12: NEBRASKA ENROLLMENT AT SDMT

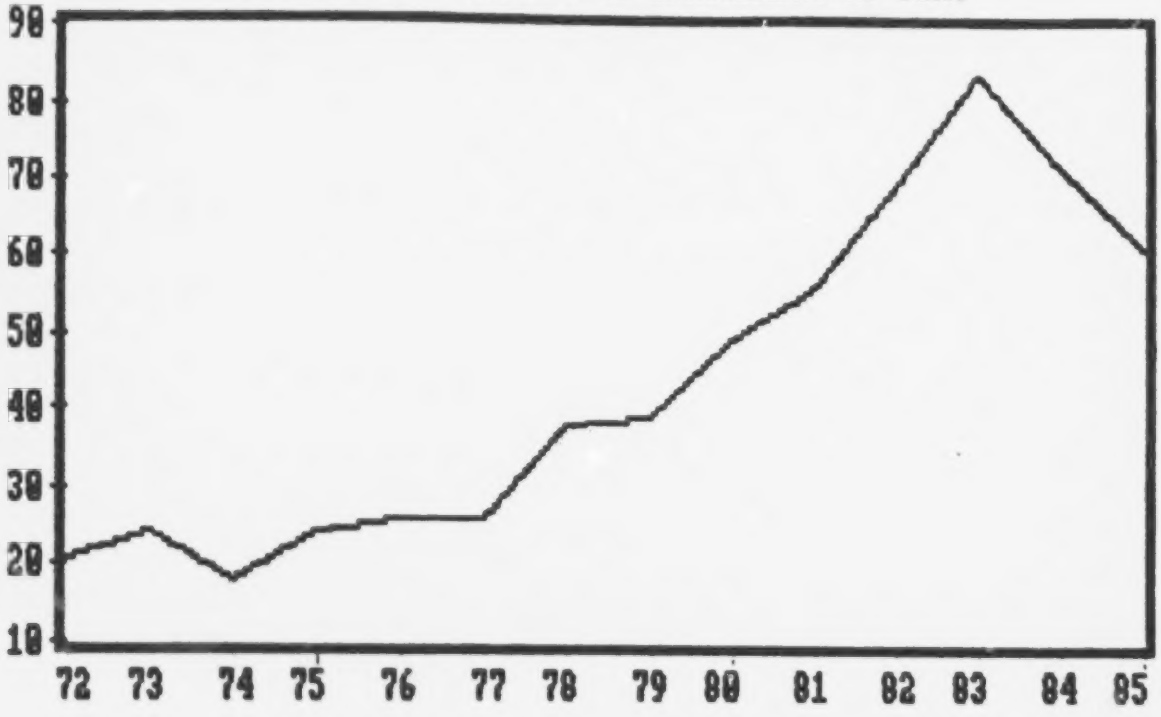


F. South Dakota State University

Like South Dakota School of Mines & Technology, South Dakota State University has seen a tremendous increase in nonresident enrollment. Within the last five years in particular, SDSU has attracted a significant number of students from Minnesota, Iowa, and other areas of the country. For the 1985-86 school year, SDSU enrolled 915 Minnesotans, 310 Iowans, and 42 Nebraskans. Only 16 students came from North Dakota, and only 4 came from Wyoming. In

addition, 334 students came from areas outside the region.

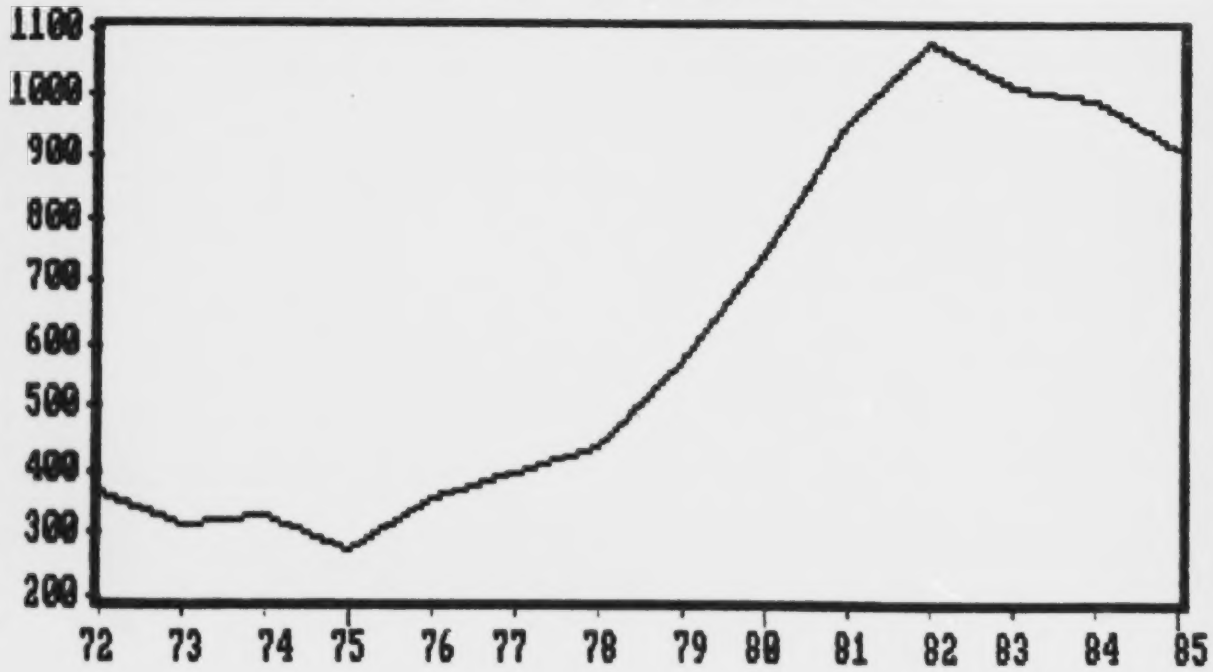
FIGURE 13: MINNESOTA ENROLLMENT AT SDMT



Obviously, Minnesota has provided the largest number of nonresidents. Figure 14 indicates that reciprocity has had a more powerful impact effect on enrollment at SDSU than any of the other South Dakota colleges and universities. In the three year period between 1977 and 1980, Minnesota enrollment almost quadrupled from 247 to 953. However, Minnesota has not only been SDSU's largest nonresident contributor; since 1980, its students have accounted for roughly 15 percent of the total undergraduate student body at the school. Minnesota enrollment has declined since 1981, but not nearly enough to undermine its overall importance to the school.

Iowa enrollment has also increased since it plummeted to a low of 159 in 1977. From 1981 to 1984, enrollment remained relatively constant at about 344. 1985 marked the sharpest decrease in enrollment since 1977.

FIGURE 14: MINNESOTA ENROLLMENT AT SDSU

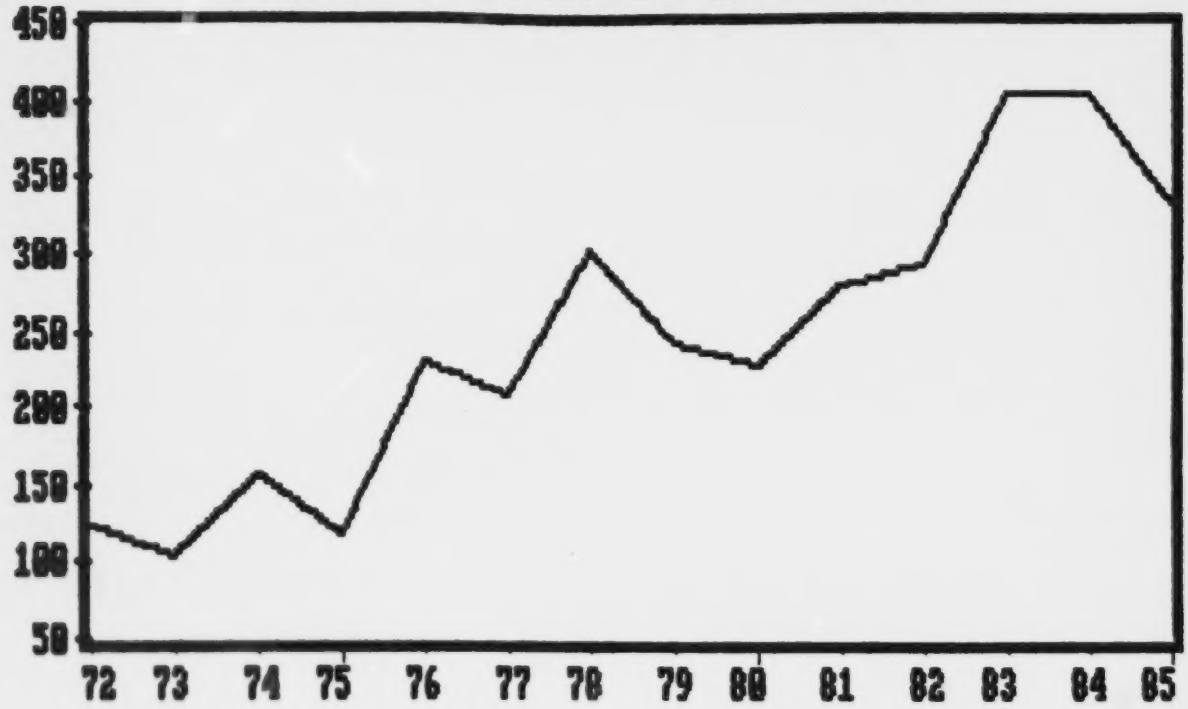


Nebraska enrollment has held steadily for the first time since 1973. In the period from 1982 to 1985, enrollment varied slightly between 42 and 45. Otherwise, enrollment followed no set pattern, sometimes changing dramatically from year to year.

Figure 15 shows that there has been a definite upward trend in enrollment from students living outside the immediate region. In 1985, SDSU enrolled 334 such students--down somewhat from 404 in 1984, but still considerably more than earlier numbers such as

103 in 1973. In 1985, 16 students came from Illinois and 26 students came from Wisconsin. In the same year, 219 foreign students enrolled at the school which is about 3 percent of the undergraduate student body.

FIGURE 15: NON-REGIONAL ENROLLMENT AT SDSU



III. THE DEMAND MODEL

A. The Price-Enrollment Relationship

The key variable of interest in this study is the nonresident tuition variable and how it is related to nonresident enrollment. Before we begin a discussion of the more sophisticated econometric demand model used to estimate this relationship we will examine the graphical relationship between the price (tuition) variable and nonresident enrollment by state and institution without controlling for other factors that could affect enrollment. That will be left to the econometric models. The tuition variable will be considered a price variable that the student must pay to attend a particular school. The price variable was constructed as the ratio of South Dakota nonresident tuition to resident tuition in an institution of similar type in the state of origin.[3] For example, the price variable for the University of South Dakota for students from Iowa was the nonresident tuition rate at the University of South Dakota as a ratio to the resident tuition at the University of Iowa. For South Dakota State University the price variable was the nonresident tuition rate at South Dakota State University as a ratio to the resident tuition rate at Iowa State University. To

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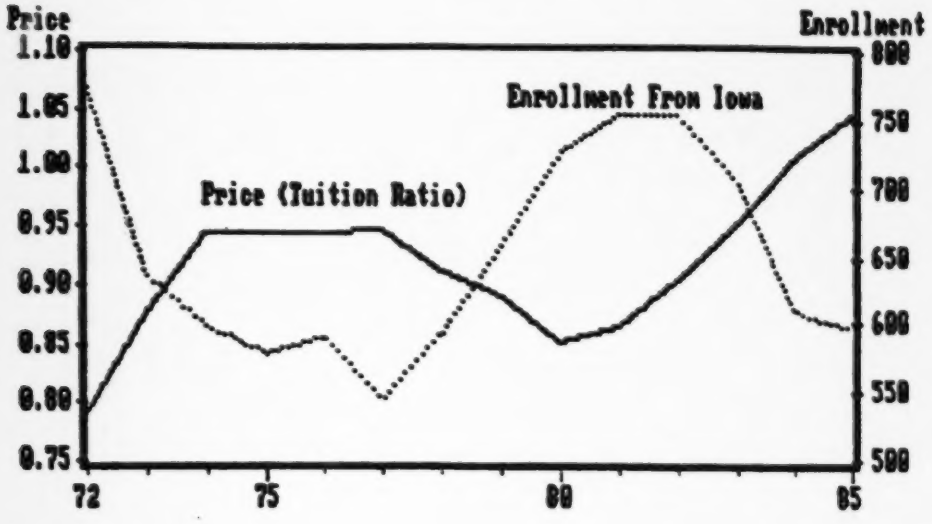
[3] Other variables examined include the tuition plus room and board variable, but this variable did not display as a statistically significant relationship to enrollment as the tuition alone variable.

the extent possible, the price variable was constructed to take into account the type of school in South Dakota as compared to the same type of school in the state of origin. Graphs of price and enrollment will be presented for selected institutions and states.

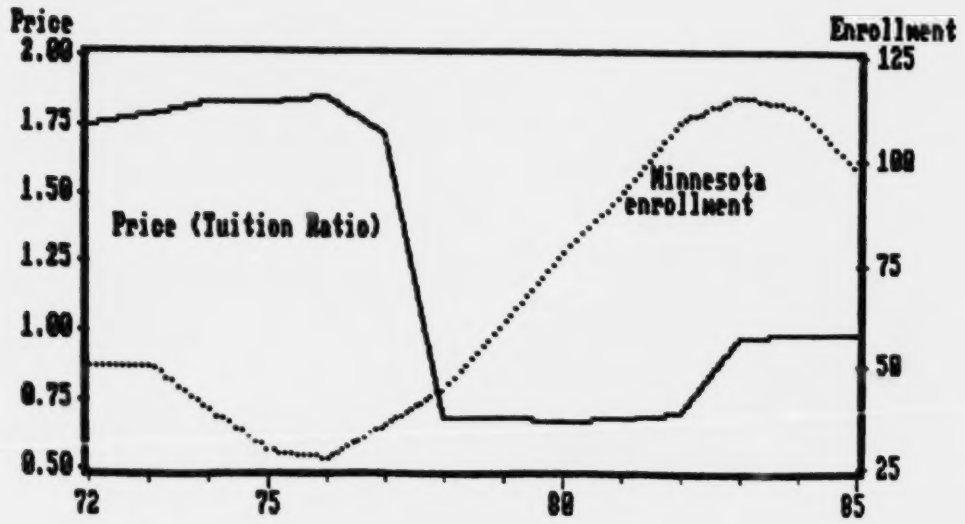
FIGURE 16: PRICE VS. ENROLLMENT FROM IOWA AT USD



The relationship between the price and enrollment from Iowa at USD is presented in Figure 16. In this graph the left scale relates to the price (stated as the ratio of nonresident tuition in South Dakota to resident tuition in the state of origin) and the right scale relates to the enrollment level. When the price variable is 1.75 this means that it would cost the nonresident student 75 percent more to attend school in South Dakota than to

attend in their own state. Examination of this graph shows that there is generally an inverse relationship between the price variable and the enrollment variable. Figures 17 and 18 show the relationship between price at USD and enrollments from the states of Minnesota and Nebraska, respectively. Once again the inverse relationship between price and enrollment is very apparent. In particular, the dramatic change in enrollment at USD from Minnesota after the tuition reciprocity agreement which began in 1978 demonstrates the influence of price on enrollment.

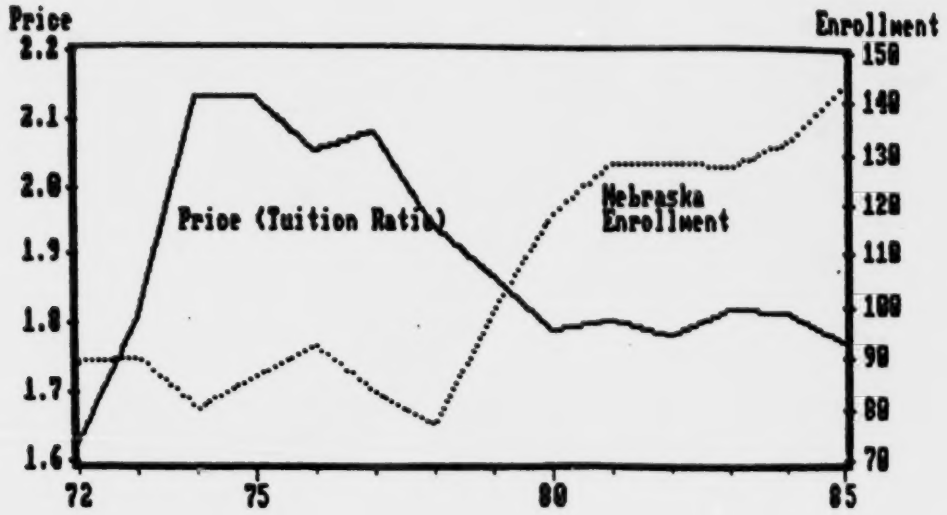
FIGURE 17: PRICE VS. ENROLLMENT FROM MINNESOTA AT USD



The graphs prepared for BHSC show the relationship between price and enrollment from North Dakota and Wyoming. (See Figures 19 and 20.) The North Dakota graph generally shows the inverse

relationship that was generally expected. However, the Wyoming graph does not show any relationship between price and enrollment. Generally, the data indicate that enrollment at BHSC from Wyoming was in a rather narrow range of 70 to 90 students from 1971 to 1982 and then increased sharply beginning in 1983. This increase was not related to any movement in price, but rather increased recruitment in Wyoming and the articulation agreements entered into by Wyoming community colleges and BHSC.

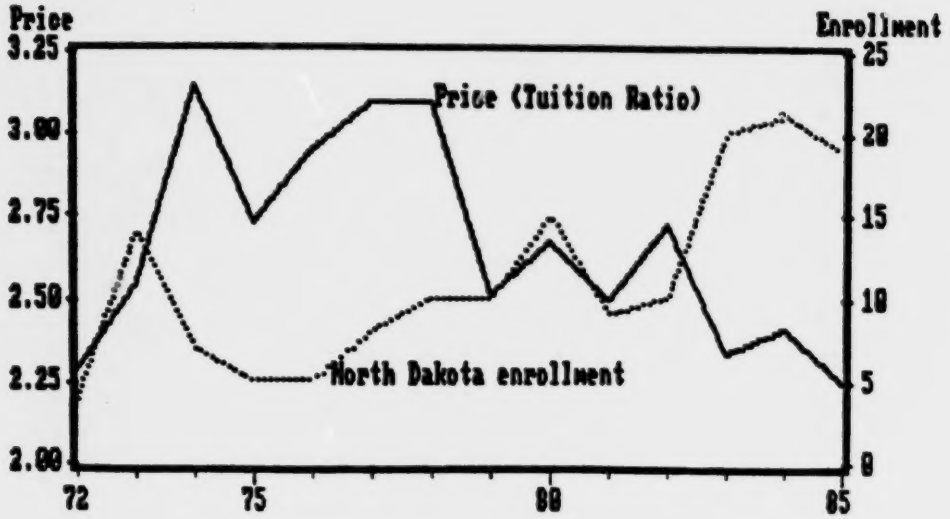
FIGURE 18: PRICE VS. ENROLLMENT FROM NEBRASKA AT USD



The relationship between price and enrollment at DSC from Minnesota is presented in Figure 21. As can be seen from this graph there is generally an inverse relationship between price and enrollment from Minnesota. The year 1982 appears to be the

only real exception to the relationship. However, when the enrollment numbers are small, as they are in this case, enrollments shifts due to other factors can dominate the relationship. There was no other meaningful relationship between price and enrollment from other states for DSC.

FIGURE 19: PRICE VS. ENROLLMENT FROM NORTH DAKOTA AT BHSC

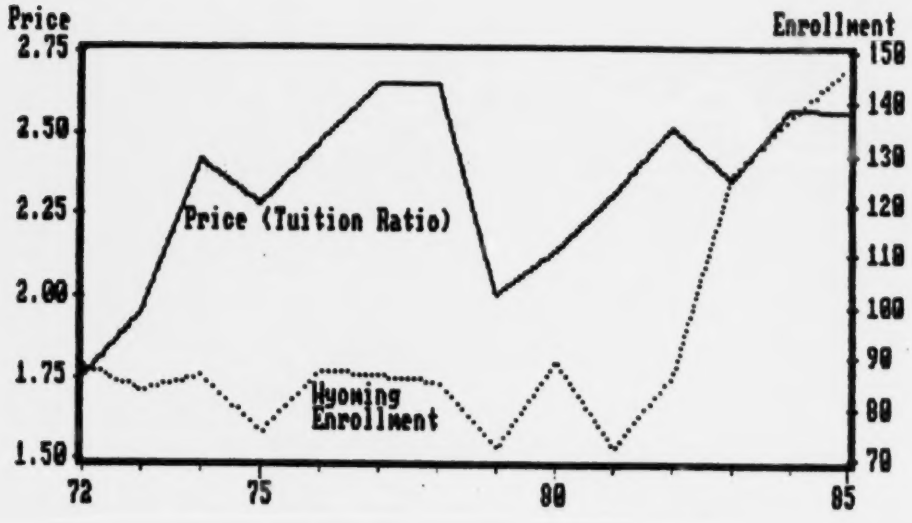


The relationship between price at NSC and enrollment from North Dakota and Minnesota are shown in Figures 22 and 23. As can be seen from examining these graphs there is a very definite inverse relationship between the price variable and enrollment from each of these states.

The enrollment from the states of North Dakota, Minnesota, and Nebraska at SDMT are presented in Figures 24, 25,

and 26. In each of these cases there is clearly an inverse relationship between price and enrollment. The trend of nonresident enrollment from outside the region versus price is shown in Figure 27. As shown in this graph there is generally an inverse relationship between price and enrollment from outside of the region.

FIGURE 20: PRICE VS. ENROLLMENT FROM WYOMING AT BHSC



The relationship between price and enrollment from Minnesota at SDSU, shown in Figure 28, shows a tremendous enrollment response to the reduction in price that accompanied the tuition reciprocity agreement of 1978. As shown in Figure 29, enrollment at SDSU from Iowa is also sensitive to changes in price. Finally, Figure 30 shows the relationship between price and enrollment

from outside the region.

FIGURE 21: PRICE VS. ENROLLMENT FROM MINNESOTA AT DSC

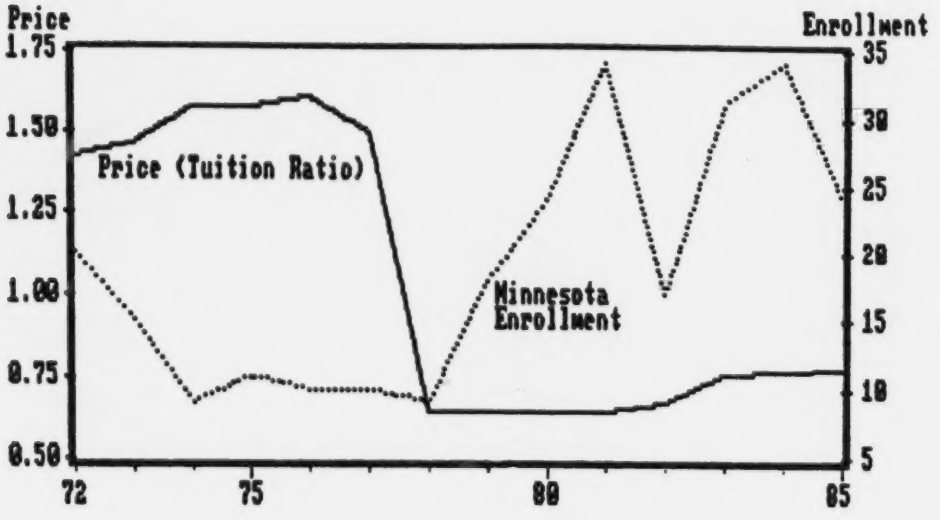


FIGURE 22: NORTH DAKOTA ENROLLMENT AT NSC

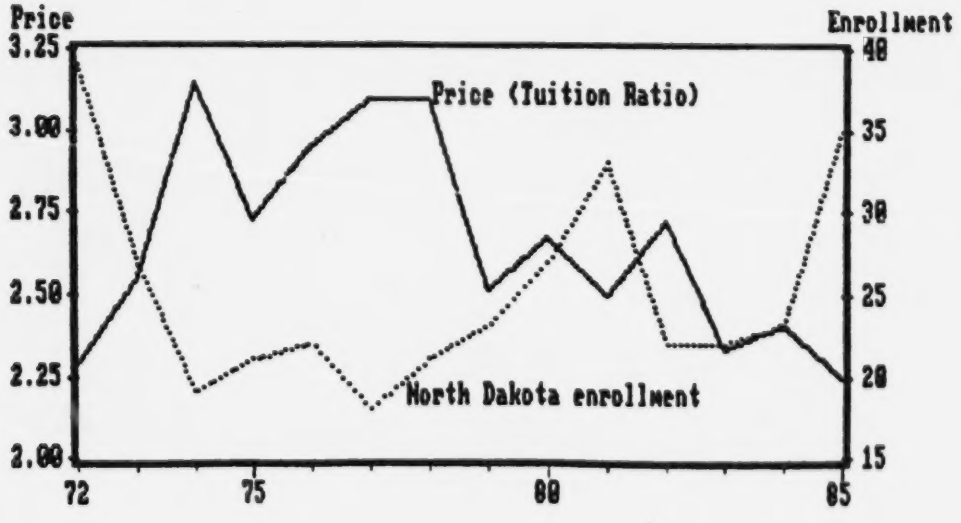


FIGURE 23: PRICE VS. ENROLLMENT FROM MINNESOTA AT NSC

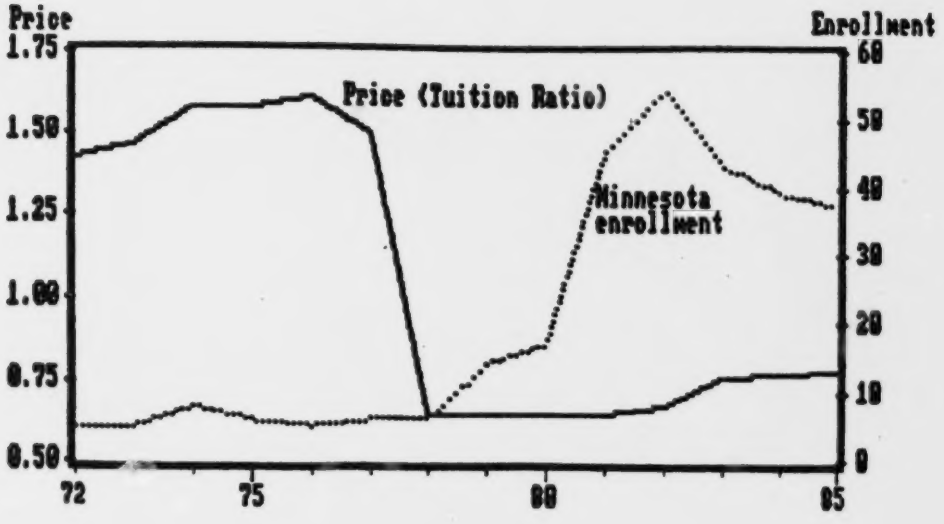


FIGURE 24: PRICE VS. ENROLLMENT FROM NORTH DAKOTA AT SDMT

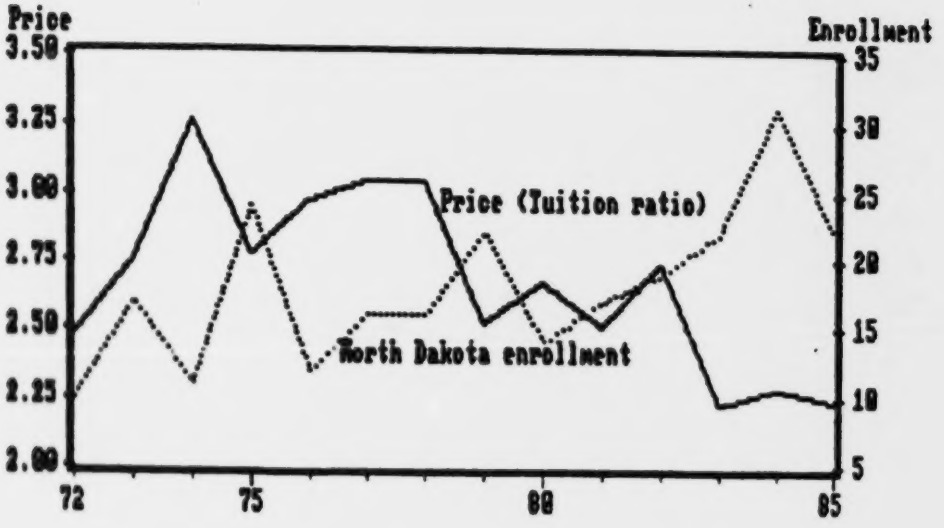


FIGURE 25: PRICE VS. ENROLLMENT FROM MINNESOTA AT SDMT

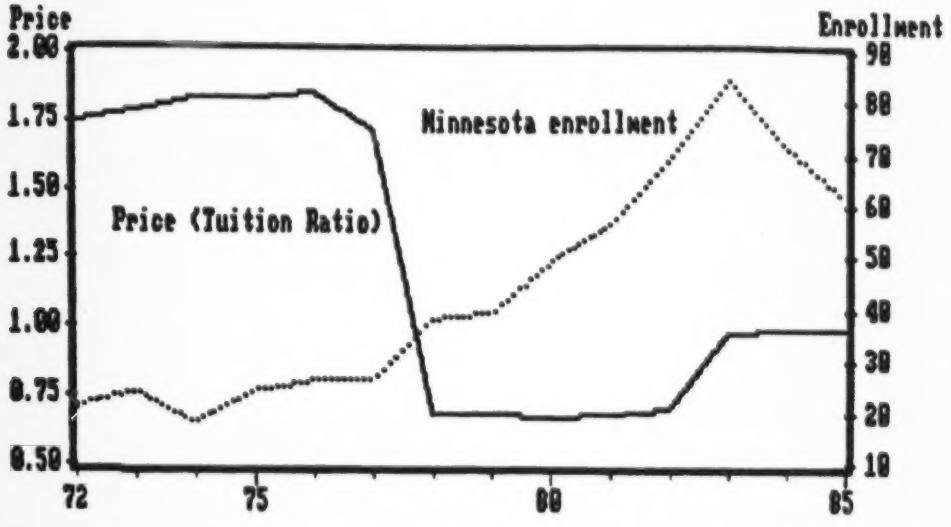


FIGURE 26: PRICE VS. ENROLLMENT FROM NEBRASKA AT SDMT

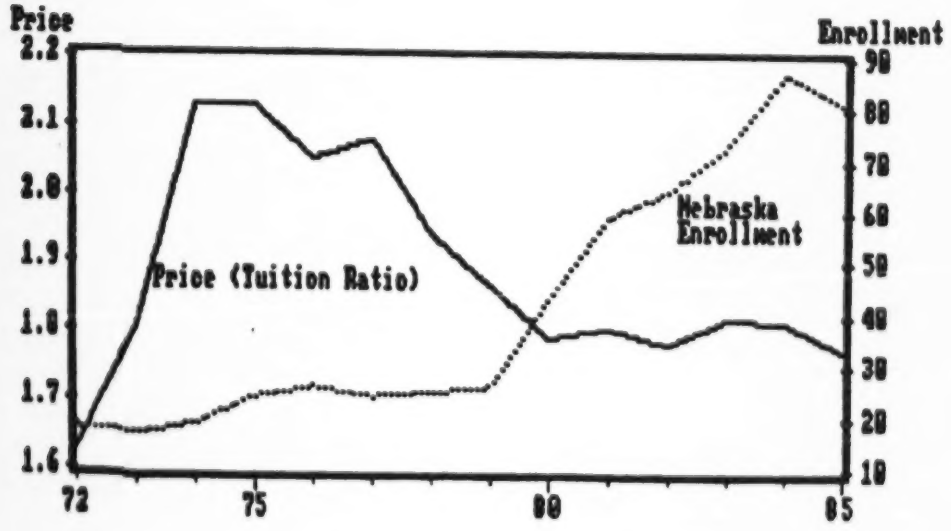


FIGURE 27: PRICE VS. ENROLLMENT FROM NON-REGION AT SDMT

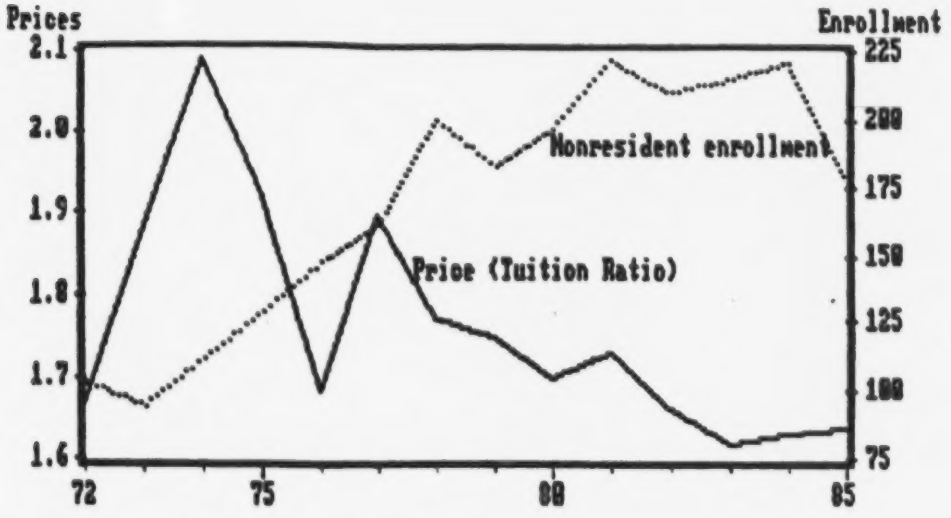


FIGURE 28: PRICE VS. ENROLLMENT FROM MINNESOTA AT SDSU

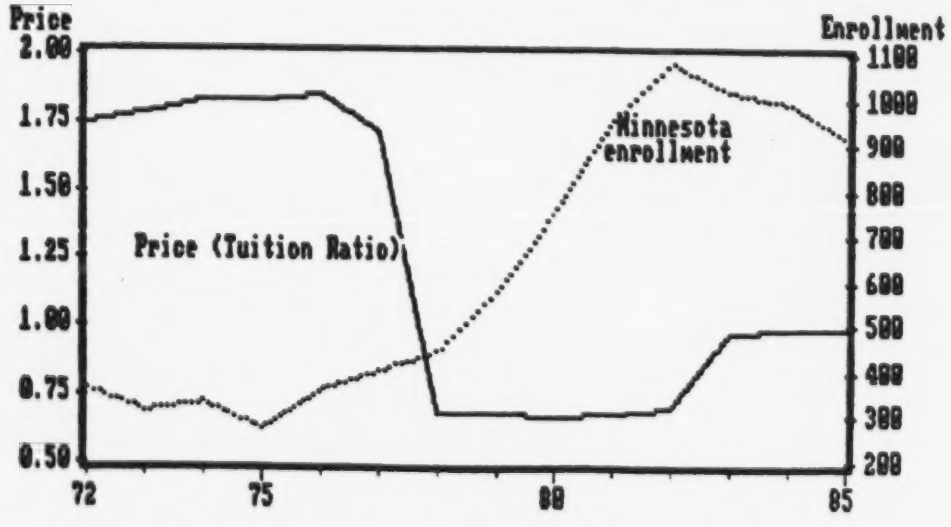


FIGURE 29: PRICE VS. ENROLLMENT FROM IOWA AT SDSU

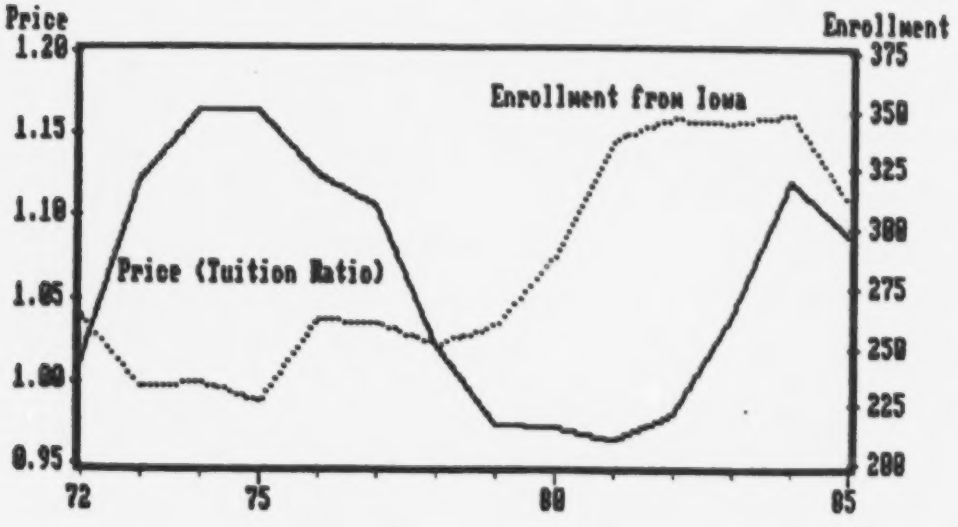
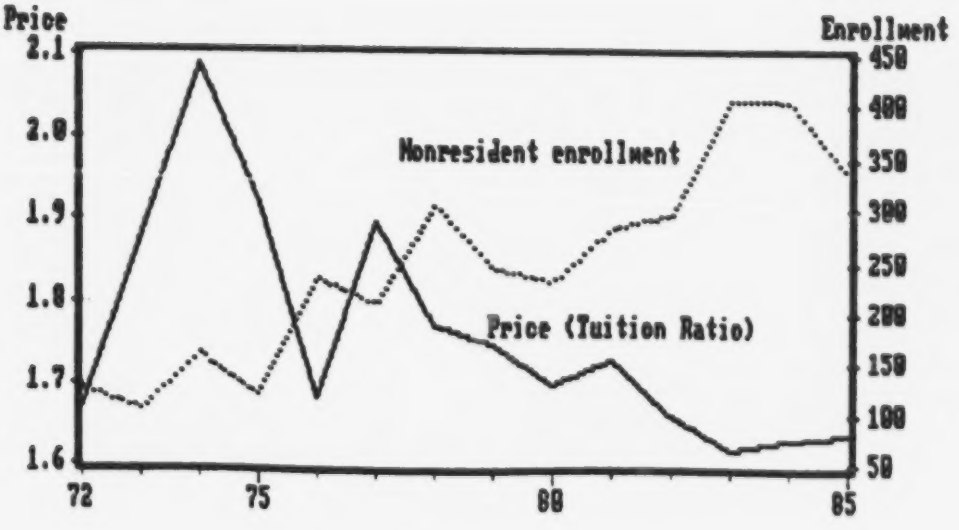


FIGURE 30: PRICE VS. ENROLLMENT FROM NON-REGION AT SDSU



B. The Econometric Demand Model

A dynamic demand model[4] was utilized to estimate the nonresident enrollment demand equations for the public institutions of higher education in South Dakota. Nonresident enrollment (the demand variable) was specified as a function of tuition ratio (the price variable), real income of the state of origin and the nonresident enrollment (dependent variable) lagged one year. The lagged dependent is introduced into the model to allow for lagged adjustment of enrollment to changes in price or income. The income variable was measured as the per capita real personal income in the state of student origin.[5] A series of six demand equations, one for each of the states of Iowa, Minnesota, North Dakota, Wyoming, Nebraska, and all other states and foreign countries, were specified and estimated using ordinary least squares. Because the data for each institution included only 14 years, 1972-1985, the time series data for each institution was

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[4] For a discussion of dynamic models see Robert S. Pindyck and Daniel L. Rubinfield, Econometric Models and Economic Forecasts, (New York: McGraw-Hill Book Company, 1981), pp.232-36.

[5] Other variables included in the regression analysis include the number of high school graduates in the state of origin, a measure of financial aid grants per recipient, and a binary dummy variable to capture the impact of a tightening of admission requirements at South Dakota schools beginning in 1983. These additional variables were not statistically significant nor did their inclusion have any significant impacts on the price variable coefficient. The only exception to this is in the case of Iowa enrollment demand where the number of Iowa high school graduates variable was of the wrong sign and statistically significant. In this case inclusion of this variable did increase the value of the price coefficient due to a high degree of multicollinearity between the price and the number of high graduates variable.

pooled to increase the sample size to 84 observations (14 years for 6 institutions).[6] To adjust for the possibility of different price response for each institution, dummy variables for each institution and interaction price variables were used. The interaction price variable is defined as the price variable times each of the institution dummy variables. This type of pooled cross-section and time series model is known as the least-squares-with-dummy-variables method (LSDV).[7] The equation form of the model is shown below as:

$$
\begin{aligned}
(1)\ EN_{it} = {} & B_0 + B_1\ PRICE_{it} + B_2\ RPCPI_t + B_3\ EN_{it-1} + \\
& B_4\ USD + B_5\ BHSC + B_6\ DSC + B_7\ NSC + B_8\ SDMT + \\
& B_9\ PRICE_{it}xUSD + B_{10}\ PRICE_{it}xBHSC + \\
& B_{11}\ PRICE_{it}xDSC + B_{12}\ PRICE_{it}xNSC + \\
& B_{13}\ PRICE_{it}xSDMT + e_{it}
\end{aligned}
$$

where EN_{it} = enrollment in the ith institution from the state of origin in year t, $PRICE_{it}$ = the ratio of nonresident tuition in the ith institution for students from the state of origin to the resident tuition in that state in year t, $RPCPI_t$ = real per capita income in the state of origin in year t, and USD, BHSC,

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[6] An example of a dynamic demand model using pooled time series and cross-section data is provided in H.S. Houthakker, P.K. Verleger, Jr., and D.P. Sheehan, "Dynamic Demand Analysis for Gasoline and Residential Electricity Demand," American Journal of Agricultural Economics, May 1974, pp. 412-18.

[7] See G.S. Maddala, Econometrics, (New York: McGraw-Hill Book Company, 1977), pp.322-31.

DSC, NSC, and SDMT are the dummy variables for each of these schools.[8] Using this approach it is possible to derive a separate demand equation for each institution. For example, in the USD equation the dummy variables for all the other institutions will be zero so that the USD equation collapses to:

$$(2)\quad EN_{it} = B_0 + B_1\ PRICE_{it} + B_2\ RPCPI_{it} + B_3\ EN_{it-1} + B_4\ USD + B_9\ PRICE_{it}xUSD + e_{it}$$

which can be rewritten as:

$$(3)\quad EN_{it} = (B_0+B_4) + (B_1+B_9)\ PRICE_{it} + B_2\ RPCPI_{it} + B_3\ EN_{it-1} + e_{it}.[9]$$

This mathematical specification of the demand equation is known as a dynamic demand relationship in that it allows for lagged response to variation in the independent variables. Essentially the model used here is a form of the stock adjustment

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[8] When using dummy variables to identify qualitative differences the procedure is to include a separate dummy variable for each characteristic less one. The left-out dummy variable is picked up by the constant coefficient in the equation. In this particular case the equation provides dummy variables for each of the institutions except South Dakota State University. In this case the impact of South Dakota State University is included in the constant term and as a consequence South Dakota State University is known as the reference institution in which all others are compared to by the use of their own dummy variables which represents adjustments or differences from South Dakota State University.

[9] The equation for South Dakota State University would be $EN_t = B_0 + B_1\ PRICE_t + B_2\ RPCPI_t + B_3\ EN_{t-1} + e_t$.

model where the enrollment adjustment to a change in price or income will be spread over time. The primary variable of concern is the impact of the price (tuition) variable on nonresident enrollment. The expected sign on this variable is negative which means as the price is raised fewer nonresident students will attend South Dakota colleges and universities. The price coefficient, B_1, can be interpreted as the change in enrollment caused by a change in the price. The B_3 coefficient on the lagged enrollment variable represents a speed of adjustment coefficient. The higher the B_3 coefficient, the faster the adjustment of enrollment to a change in the price or income variable. The long run speed of adjustment to a change in the price variable is computed as:

(4) $$\text{Long Run Change in Enrollment (Due to a Change in Price)} = B_1/(1-B_3)$$

C. Price Elasticity of Demand

The price elasticity of demand coefficient conveys information about the sensitivity of enrollment to changes in the price. It is defined as the ratio of the percentage change in enrollment to a given percentage change in the price. That is:

(5) Price Elasticity Coefficient[10] = $\frac{\text{\% Change in Enrollment}}{\text{\% Change in Price.}}$

If the absolute value of the price elasticity coefficient is less than 1, then demand is price inelastic. This means that the percentage response in enrollment is less than the percentage change in the price. Therefore, if the elasticity coefficient is -0.5, a 10 percent reduction in the price will cause a 5 percent increase in enrollment. If the absolute value of the price elasticity coefficient is greater than 1, then demand is price elastic. For example, if the price elasticity coefficient is -1.5, a 10 percent reduction in the price will cause a 15 percent increase in enrollment. In this case the percentage change in enrollment is greater than the percentage change in the price or enrollment demand is very price sensitive.

Using the dynamic demand specification allows the estimation of short-run and long-run price elasticities. The short-run price elasticity is computed using equation (5) shown above. Short-run price elasticity represents the response of enrollment to a change in the price in the first year. The long-run price elasticity is computed using a variant of equation (4) and (5). The equation for long-run price elasticity is as follows:

---

[10] The elasticity at the mean value of price and enrollment can be calculated using the PRICE coefficient of equation (3) and the following formula:

B_1 X (mean PRICE/ mean EN).

(6) $$\text{Long-Run Price Elasticity Coefficient} = \frac{\text{Short-Run Price Elasticity Coefficient}}{(1-B_3)}.$$

Long-run price elasticity represents the total multi-year change in enrollment due to change in the price.

D. Marginal Revenue

In order to determine the impact of a price change on the total revenue received by the firm or institution in this case, one must consider the effect of lowering price on additional enrollment as well as the effect of the lower price on the revenue obtained from those who would have enrolled at the previous higher price. The economic concept that deals with this idea is the concept of marginal revenue. The marginal revenue in this study is defined as the additional revenue attributable to the addition of one more nonresident student. Keeping in mind that to attract one more student the price must be lowered, the marginal revenue will always be lower than the price since the school must lower its price on all nonresident students to attract the additional student. The marginal revenue can be computed from the price elasticity coefficient using the following formula:[11]

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[11] For a discussion of this concept see any microeconomics text such as Edwin Mansfield, Microeconomics: Theory and Applications, (New York: W.W. Norton & Co., 1985), pp. 136-40.

(7) Marginal Revenue = Price[1-(1/elasticity)]

The marginal revenue, when compared with the marginal cost of each additional student, will provide a measure of the additional net revenue attributable to any price change policy.

IV. THE RESULTS OF THE STATISTICAL ANALYSIS

The least-squares-dummy-variable method of estimating the coefficients of the model was applied to the pooled sample for each state. In all six, regression equations were estimated: one for Iowa, Minnesota, North Dakota, Nebraska, Wyoming, and all other states and foreign countries.

A. The Iowa Equation

The results of the Iowa equation are presented in Figure 31.[12] Generally, the results are very satisfactory with an adjusted R^2 of .985. All the variables with the exception of the RPCPI had the correct signs and were statistically significant. In this particular regression USD was used as the reference institution by not including it as a separate dummy variable. As discussed in the previous section separate demand equations for each institution can be derived. These separate equations for Iowa are shown below.

USD	$EN_t = 1320.3 - 418.4\ PRICE_t + 0.003\ RPCPI_t$
BHSC	$EN_t = -26.4 - 1.7\ PRICE_t + 0.003\ RPCPI_t$
DSC	$EN_t = -52.9 - 40.6\ PRICE_t + 0.003\ RPCPI_t$
NSC	$EN_t = -5.6 - 26.0\ PRICE_t + 0.003\ RPCPI_t$

[12] The dynamic demand model did not provide useful results due to a high degree of collinearity between the lagged enrollment variable and the PRICE variable and therefore the standard demand model without the lagged dependent variable was used for Iowa. This was also true for the state of Nebraska.

SDMT $EN_t = -31.7 - 15.8\ PRICE_t + 0.003\ RPCPI_t$

SDSU $EN_t = -436.1 - 109.9\ PRICE_t + 0.003\ RPCPI_t$

In only the cases of USD and SDSU was the PRICE variable statistically significant. In other words, varying the price at BHSC, DSC, NSC, and SDMT would have little impact on enrollment from Iowa. Given the types of these schools and their geographic location this result was expected.

FIGURE 31: THE IOWA EQUATION

84 Observations
LS // Dependent Variable is ENIA

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1320.2762	160.52398	8.2247908	0.000
PRICE	-418.40424	87.090045	-4.8042717	0.000
RPCPI	0.0032964	0.0068885	0.4785292	0.634
BHSC	-1346.6851	180.43856	-7.4633998	0.000
DSC	-1273.2255	180.43856	-7.0562827	0.000
NSC	-1325.8514	180.43856	-7.3479380	0.000
SMT	-1352.0383	204.46485	-6.6125710	0.000
SDSU	-884.18675	204.46485	-4.3243948	0.000
PBHSC	416.70501	109.67723	3.7993759	0.000
PDSC	377.77290	109.67723	3.4444060	0.001
PNSC	402.56175	109.67723	3.6704224	0.000
PSMT	421.05973	120.10176	3.5058582	0.001
PSDSU	308.45220	120.10176	2.5682572	0.013

R-squared	0.984518	Mean of dependent var	161.5119
Adjusted R-squared	0.981901	S.D. of dependent var	244.2428
S.E. of regression	32.85865	Sum of squared resid	76658.07
F-statistic	376.2396		

B. <u>The Minnesota Equation</u>

The results of the regression analysis for Minnesota are presented in Figure 32. The regression results for this state

FIGURE 32: THE MINNESOTA EQUATION

84 Observations
LS // Dependent Variable is ENMN

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	418.63666	75.133589	5.5718976	0.000
ENMN(-1)	0.8118557	0.0347262	23.378773	0.000
PRICE	-159.07702	19.432388	-8.1861799	0.000
RPCPI	-0.0067112	0.0060489	-1.1094974	0.271
USD	-297.16150	42.689194	-6.9610475	0.000
BHSC	-330.13641	45.834860	-7.2027362	0.000
DSC	-323.12548	45.212713	-7.1467837	0.000
NSC	-316.61904	44.816886	-7.0647264	0.000
SMT	-312.22595	43.461883	-7.1839029	0.000
PUSD	132.81356	24.117233	5.5069984	0.000
PBHSC	145.95283	27.148407	5.3761104	0.000
PDSC	141.45553	27.010897	5.2369801	0.000
PNSC	137.05975	26.777515	5.1184642	0.000
PSMT	140.85145	24.210196	5.8178567	0.000

R-squared	0.989560	Mean of dependent var	130.1190
Adjusted R-squared	0.987621	S.D. of dependent var	255.3204
S.E. of regression	28.40760	Sum of squared resid	56489.41
F-statistic	510.3625		

were satisfactory with an adjusted R^2 of .988. Like the Iowa regression all the variables were statistically significant except the RPCPI variable. In this particular regression SDSU was used as the reference institution and therefore the constant and PRICE coefficients refer to SDSU. The equations for each school are as follows.

USD $EN_t = 121.4 - 26.3\ PRICE_t - 0.007\ RPCPI_t + .81\ EN_{t-1}$

BHSC $EN_t = 88.5 - 13.1\ PRICE_t - 0.007\ RPCPI_t + .81\ EN^t_{-1}$

DSC $EN_t = 95.5 - 17.6\ PRICE_t - 0.007\ RPCPI_t +$

$$+ .81\ EN^{t}_{-1}$$

NSC $\quad EN_t = 102.0 - 22.0\ PRICE_t - 0.007\ RPCPI_t$

$$+ .81\ EN^{t}_{-1}$$

SDMT $\quad EN_t = 106.4 - 18.2\ PRICE_t - 0.007\ RPCPI_t$

$$+ .81\ EN^{t}_{-1}$$

SDSU $\quad EN_t = 418.6 - 159.1\ PRICE_t - 0.007\ RPCPI_t$

$$+ .81\ EN^{t}_{-1}$$

The PRICE variable for Minnesota was statistically significant in the cases of USD, SDSU, DSC, NSC, and SDMT. Minnesota was the state that was most sensitive to changes in the South Dakota nonresident tuition rate.

c. The North Dakota Equation

The results of the North Dakota equation are presented in Figure 33. The reference equation for this run was NSC so the dummy and PRICE interaction variables for each of the other schools can be used to adjust for their differences relative to NSC in terms of PRICE response. Generally, the results of this regression analysis are satisfactory with an adjusted R^2 of .807. Most of the variables were statistically different from zero. The PRICE variable was statistically significant as were all the PRICE interaction variables except for SDMT. Essentially the insignificance of the SDMT PRICE interaction variable can be interpreted as the PRICE response of enrollments at NSC and SDMT

were not statistically different. As has been the case in most

FIGURE 33: THE NORTH DAKOTA EQUATION

84 Observations
LS // Dependent Variable is ENND

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	56.033430	11.475731	4.8827765	0.000
ENND(-1)	0.2581064	0.0951775	2.7118415	0.009
PRICE	-14.158607	3.6077429	-3.9245056	0.000
RPCPI	-2.814D-05	0.0003226	-0.0872407	0.931
USD	-46.561855	13.775352	-3.3800846	0.001
BHSC	-31.918768	13.251972	-2.4086051	0.019
DSC	-51.956668	14.243691	-3.6476968	0.001
SMT	-17.713273	13.384855	-1.3233818	0.190
SDSU	-43.965391	13.724155	-3.2035045	0.002
PUSD	12.495660	4.9629207	2.5178037	0.014
PBHSC	8.5557654	4.7920097	1.7854232	0.079
PDSC	12.966098	5.0659062	2.5594825	0.013
PSMT	5.0621047	4.9238267	1.0280834	0.308
PSDSU	12.413528	4.8372640	2.5662291	0.013

R-squared	0.837281	Mean of dependent var	11.76190
Adjusted R-squared	0.807062	S.D. of dependent var	9.168594
S.E. of regression	4.027282	Sum of squared resid	1135.330
F-statistic	27.70686		

other regression equations the RPCPI variable was not statistically significant. The separate equations for each institution are shown below.

USD $EN_t = 9.4 - 1.7\ PRICE_t - 0.00003\ RPCPI_t + 0.26\ EN_{t-1}$

BHSC $EN_t = 24.1 - 5.6\ PRICE_t - 0.00003\ RPCPI_t + 0.26\ EN_{t-1}$

DSC $EN_t = 4.0 - 1.2\ PRICE_t - 0.00003\ RPCPI_t + 0.26\ EN_{t-1}$

NSC $EN_t = 56.0 - 14.2\ PRICE_t - 0.00003\ RPCPI_t + 0.26\ EN_{t-1}$

SDMT $EN_t = 38.3 - 9.1\ PRICE_t - 0.00003\ RPCPI_t + 0.26\ ENi_{t-1}$

SDSU $EN_t = 12.0 - 1.8\ PRICE_t - 0.00003\ RPCPI_t + 0.26\ EN_{t-1}$.

In only the cases of NSC, SDMT and BHSC was the PRICE variable statistically significant. The enrollment from North Dakota at BHSC was somewhat surprising. In the other schools the enrollment from North Dakota was extremely small.

D. The Nebraska Equation

The results of the regression analysis for Nebraska are presented in Figure 34. USD was used as the reference institution. There is one difference in the specification of this equation. The lagged dependent variable specification did not prove to be significant, so the equation did not include a lagged dependent variable. This specification allows only the long-run elasticity to be computed, otherwise the interpretation is the same. The regression results for this state were satisfactory with an adjusted R^2 of .906. In this regression the PRICE and RPCPI variables had the right signs and were statistically significant. The dummy variable and PRICE interaction variable for SDMT were not significant which means that there was not a

FIGURE 34: THE NEBRASKA EQUATION

84 Observations
LS // Dependent Variable is ENNE

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	46.423524	25.909566	1.7917523	0.078
PRICE	-34.637764	11.264286	-3.0750075	0.003
RPCPI	0.0117213	0.0020567	5.6990434	0.000
BHSC	-178.79852	43.987616	-4.0647468	0.000
DSC	-174.93255	43.987616	-3.9768590	0.000
NSC	-182.87009	43.987616	-4.1573085	0.000
SMT	-34.106521	47.749156	-0.7142853	0.478
SDSU	-178.74650	47.749156	-3.7434483	0.000
PBHSC	51.499393	26.922277	1.9128914	0.060
PDSC	46.610824	26.922277	1.7313106	0.088
PNSC	50.808048	26.922277	1.8872121	0.064
PSMT	-15.445032	25.158128	-0.6139182	0.541
PSDSU	59.752437	25.158128	2.3750749	0.021

R-squared	0.919564	Mean of dependent var	32.72619
Adjusted R-squared	0.905969	S.D. of dependent var	39.36525
S.E. of regression	12.07117	Sum of squared resid	10345.64
F-statistic	67.64032		

significant difference between the PRICE response at either USD, the reference institution, or SDMT. The equations for each school are as follows.

USD $EN_t = 46.4 - 34.6\ PRICE_t + 0.012\ RPCPI_t$

BHSC $EN_t = -132.4 + 16.9\ PRICE_t + 0.012\ RPCPI_t$

DSC $EN_t = -128.5 + 12.0\ PRICE_t + 0.012\ RPCPI_t$

NSC $EN_t = -136.5 + 16.2\ PRICE_t + 0.012\ RPCPI_t$

SDMT $EN_t = 12.3 - 19.2\ PRICE_t + 0.012\ RPCPI_t$

SDSU $EN_t = -132.0 + 0.9\ PRICE_t + 0.012\ RPCPI_t$

The PRICE variable for Nebraska was significant only in the

cases of USD and SDMT.

E. The Wyoming Equation

The results of the regression analysis for Wyoming are presented in Figure 35. The regression results for this state were satisfactory in terms of the adjusted R^2 of .987. However, this was the only state in which the PRICE coefficient was not statistically significant. Since this equation does not show any significant PRICE effects the individual equations are not listed.

FIGURE 35: THE WYOMING EQUATION

84 Observations
LS // Dependent Variable is ENWY

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	2.9415753	29.376427	0.1001339	0.921
PRICE	10.471534	10.123179	1.0344115	0.305
RPCPI	0.0003869	0.0011320	0.3417605	0.734
USD	3.8005525	38.266273	0.0993186	0.921
BHSC	12.489304	35.807799	0.3487873	0.728
DSC	-6.2652244	35.807799	-0.1749681	0.862
NSC	-5.8963772	35.807799	-0.1646674	0.870
SDSU	-4.1856931	38.263600	-0.1093910	0.913
PUSD	-13.658121	14.298139	-0.9552377	0.343
PBHSC	21.413248	14.213303	1.5065638	0.137
PDSC	-10.743486	14.213303	-0.7558753	0.452
PNSC	-10.166860	14.213303	-0.7153059	0.477
PSDSU	-10.310521	14.297195	-0.7211569	0.473

R-squared	0.931928	Mean of dependent var	23.03571
Adjusted R-squared	0.920423	S.D. of dependent var	35.70274
S.E. of regression	10.07155	Sum of squared resid	7201.967
F-statistic	81.00081		

F. The All Other States and Foreign Countries Equation

The results of the regression analysis for all other states outside the region and foreign countries is presented in Figure 36. The regression results were satisfactory with an adjusted R^2 of .909 and a statistically significant PRICE variable. All of the variables were statistically significant with the exception of the RPCPI variable. The separate equations for each institution are presented below.

USD $EN_t = -139.5 + 83.2\ PRICE_t + 0.024\ RPCPI_t + 0.60\ EN_{t-1}$

BHSC $EN_t = -25.8 + 4.2\ PRICE_t + 0.024\ RPCPI_t + 0.60\ EN_{t-1}$

DSC $EN_t = -54.6 + 7.2\ PRICE_t + 0.024\ RPCPI_t + 0.60\ EN_{t-1}$

NSC $EN_t = -43.9 + 2.2\ PRICE_t + 0.024\ RPCPI_t + 0.60\ EN_{t-1}$

SDMT $EN_t = +59.1 - 23.4\ PRICE_t + 0.024\ RPCPI_t + 0.60\ EN_{t-1}$

SDSU $EN_t = 384.6 - 187.8\ PRICE_t + 0.024\ RPCPI_t + 0.60\ EN_{t-1}$.

The PRICE variable was significant only in the cases of SDMT and SDSU.

FIGURE 36: THE OTHER STATES AND FOREIGN COUNTRIES EQUATION

84 Observations
LS // Dependent Variable is ENOT

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	384.58956	136.59556	2.8155349	0.006
ENOT(-1)	0.6049210	0.0900890	6.7147075	0.000
PRICE	-187.78023	67.061917	-2.8001024	0.007
RPCPI	0.0240019	0.0191702	1.2520418	0.215
USD	-524.09764	169.18045	-3.0978618	0.003
BHSC	-410.40559	157.84594	-2.6000390	0.012
DSC	-439.35331	159.46886	-2.7551041	0.008
NSC	-428.47320	158.21073	-2.7082437	0.009
SMT	-325.53035	143.33547	-2.2711082	0.026
PUSD	271.03757	93.977689	2.8840630	0.005
PBHSC	192.00189	82.603704	2.3243738	0.023
PDSC	195.04361	82.030903	2.3776845	0.020
PNSC	190.02240	81.533727	2.3305987	0.023
PSMT	164.38776	80.446605	2.0434394	0.045

R-squared	0.922937	Mean of dependent var	119.1071
Adjusted R-squared	0.908626	S.D. of dependent var	91.17149
S.E. of regression	27.55947	Sum of squared resid	53166.70
F-statistic	64.48868		

G. The Price Elasticity Estimates

The price elasticity of demand estimates were computed for each state and institution where the price variables were statistically significant.[13] In all states except for Iowa, Nebraska, and Wyoming, both short-run (one year) and long-run elasticity estimates were computed. They were not computed for Iowa and Nebraska because these equations did not include the lagged dependent variable and they were not included for Wyoming because the price variable was not significant in this equation. The price elasticity estimates are presented in Table 1.

As shown in Table 1, the states that demonstrated a significant price response at USD were Iowa, Minnesota, and Nebraska. For Minnesota the long-run elasticities were elastic[14] which indicates that the percentage change in enrollment was greater than the percentage change in price. The interpretation of the data in Table 1 is as follows: for Iowa students at USD the short-run price elasticity is -0.65 which means a 5 percent drop in the price would be expected to lead to a 3.25 percent (-0.65 X -5 percent) increase in enrollment of Iowa students at USD. For Nebraska the short-run elasticity was inelastic which means that the percentage change in enrollment was less than the

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[13] All price elasticity estimates were computed at the mean values of price and enrollment.

[14] The absolute value of the price elasticity coefficient is greater than one. If the absolute value of the price elasticity coefficient is less than one than demand is said to be inelastic.

percentage change in price. In the case of Nebraska where the short-run elasticity is -0.40, a 5 percent drop in the price would lead to a 2.0 percent (-0.40 X 5 percent) increase in enrollment from Nebraska at USD.

The price variable was statistically significant for SDSU from the states of Iowa, Minnesota, and all other states and foreign countries. In all of these cases the long-run price elasticity was elastic. For DSC the only statistically significant state was Minnesota, in which the long-run price elasticity was elastic. NSC had a statistically significant price response for the states of Minnesota and North Dakota. In both of these cases the short-run and long-run elasticity was elastic. SDMT had the most states with a statistically significant price response. These states include Minnesota, Nebraska, North Dakota, and all other states and foreign countries. For BHSC a statistically significant price variable was found only in the case of North Dakota. As discussed above there was no statistically significant price response for Wyoming.

TABLE 1

PRICE (TUITION) ELASTICITIES OF DEMAND

MEASURED AT MEAN PRICES AND QUANTITIES

SCHOOL	IA	MN	NE	ND	WY	OTHER
USD						
Price Elast. (SR)	-0.65	-0.48	-0.40	0	0	0
Price Elast. (LR)	NA	-2.53	NA	0	0	0
SDSU						
Price Elast. (SR)	-0.76	-0.31	0	0	0	-1.35
Price Elast. (LR)	NA	-1.63	0	0	0	-3.46
DSC						
Price Elast. (SR)	0	-0.97	0	0	0	0
Price Elast. (LR)	0	-5.12	0	0	0	0
NSC						
Price Elast. (SR)	0	-1.22	0	-1.50	0	0
Price Elast. (LR)	0	-6.40	0	-2.02	0	0
SDMT						
Price Elast. (SR)	0	-0.51	-2.48	-1.35	0	-0.25
Price Elast. (LR)	0	-2.71	NA	-1.87	0	-0.64
BHSC						
Price Elast. (SR)	0	0	0	-1.33	0	0
Price Elast. (LR)	0	0	0	-1.79	0	0

H. Marginal Revenue Estimates

Marginal revenue estimates were computed using the price elasticity estimates presented in Table 1 and the formula presented in equation (7). Marginal revenue is a key indicator because it shows the additional revenue attributable to the addition of one more student. It takes into account the net revenue received by the institution and includes the effect of lowering price on additional enrollment as well as the effect of the lower price on the lower revenue obtained from those who would have enrolled at the previous higher price. Estimates of the marginal revenue (stated in annual revenue from tuition assuming 32 credit hours at the nonresident tuition rate) are presented in Table 2. These estimates are provided for a range of credit hour rates ranging from $29.50 per credit hour to $69.50 per credit hour and different elasticity estimates ranging from -1.25 to -2.75. The Table should be read as follows: assuming a credit hour charge for nonresident students of $69.50 per hour and elasticity estimate of -2.00, the marginal revenue per student is $1,112. In other words, if the elasticity coefficient is -2.00 and the nonresident tuition rate is $69.50 per credit hour lowering the tuition rate a small amount, assume $1.00, would increase the revenue to the institution by $1,112. Again this is stated in annual terms. The reason that the revenue does not increase by $2,224 ($69.00 X 32 hours) is to increase that enrollment the tuition rate must be cut for all nonresident

students which partially[15] offsets the revenue increasing effects the additional new students induced by the lower tuition charge. Note the higher the nonresident tuition rate the higher the marginal revenue. Note also that the higher the elasticity estimate (in absolute value terms) the higher the marginal revenue estimates. In the next sections marginal cost estimates will be derived, which, when compared with marginal revenue, will provide a measure of the additional net revenue attributable to any price change policy.

TABLE 2

RELATIONSHIP BETWEEN ELASTICITY, PRICE AND MARGINAL REVENUE

Tuition Per Hour	Price Elasticity						
	-1.25	-1.50	-1.75	-2.00	-2.25	-2.50	-2.75
	Marginal Revenue (Annual $'s)						
$29.50	$189	$315	$405	$472	$524	$566	$601
34.50	221	368	473	552	613	662	703
39.50	253	421	542	632	702	758	804
44.50	285	475	610	712	791	854	906
49.50	317	528	679	792	880	950	1,008
54.50	349	581	747	872	969	1,046	1,110
59.50	381	635	816	952	1,058	1,142	1,212
64.50	413	688	885	1,032	1,147	1,238	1,313
69.50	445	741	953	1,112	1,236	1,334	1,415

[15] The extent to which the revenue loss from the existing students paying lower tuition offsets the revenue effects of the new students is determined by the price elasticity of demand. If the absolute value of the price elasticity is greater than one, demand is elastic, there will not be a total offset. If this value is less than one, demand is inelastic, the revenue loss from charging existing students less will more than offset the increased revenue from the additional new students.

V. THE COST MODEL

It should now be clearly understood that changing tuition rates for nonresident students affects the number of such students attending institutions of higher learning in South Dakota, and this, in turn, affects the tuition revenues received by the institutions. However, no inquiry into the financial impact of changing tuition rates is complete, or even useful, unless the influence of such changes on the cost of operation is also ascertained. This section of the report investigates the relationship between the number of students and the cost of operating institutions of higher learning in South Dakota.

Our procedure for investigating this relationship employs standard economic principles. The process of educating students is, we suggest, adequately described by the usual production paradigm. Inputs, or resources, are purchased and are used to produce the outputs of the institution. Leaving aside for the moment the important question of how outputs are to be defined, it is clear that if higher education is perceived in this way, then it can be at least intuitively appreciated that some sort of relationship should exist between the magnitude of the output and the expenditures made by institutions of higher learning. More rigorously, if production takes place under given technological conditions, and if the quality of the product does not change, then as the amount produced increases the total cost

of the enterprise should rise as well. The reason for such a relationship is straightforward: production takes resources, or inputs, and more production requires more resources. Resources cost money, ergo, more production implies greater expenditures.

If this is so, then it is clear that it is possible, at least conceptually, to determine the additional cost incurred as a result of additional output. The term "marginal cost" is used by economists to describe the extra cost associated with increasing output by a very small amount, usually one unit. (Of course, marginal cost will also describe the decline in cost associated with a reduction in output by one unit). This extra cost can be compared with revenues received as a result of the extra output, thereby determining the financial impact of changed enrollment.

A. Definitions and Sources of Data

While not completely satisfactory, we define output in terms of the number of graduate and undergraduate students enrolled. Institutions of higher learning are thus seen as being analogous to multi-product firms, with the number of undergraduate students being one product, and the number of graduate students another. We distinguish between the two types of students because differences exist between the two which plausibly have some impact on costs; graduate student class size tends to be smaller, professors who teach graduate students command, as a general

rule, higher salaries, and student thesis writing often takes up immense quantities of an advisor's (as well as the student's) time. Hence graduate education tends to be more expensive than undergraduate, and the cost of undergraduate education should somehow be separated from the cost of graduate education.

As suggested above, defining output in terms of student numbers suffers from a number of shortcomings, not the least of which is the fact that colleges and universities do not really produce students; they provide students with certain skills, techniques, and general intellectual adeptness. Ideally, it would be the cost of providing, or producing, these things in and for students which we would wish to measure. Such a task, however, is beyond our powers, and, in any event, our procedure must be guided by the practical consideration which requires our measure of output on the cost side to be commensurable with that on the revenue side. The analysis of the impact of tuition charges , we recall, was done in terms of the number of students. Coupling this with the fact that the number of graduate and undergraduate students by institution for the years 1975 to 1985 for all public institutions of higher learning in the state were easily obtainable from Board of Regents reports, made the case for defining output in this way irresistible.

The data on cost, broken down into various categories, was obtained from the Higher Education General Information Survey (HEGIS). We were able to acquire reasonably consistent data on all six institutions for the years 1975 to 1985. We then pooled

the data from each institution for the years 1975 to 1985 (the time series portion of the data) with that from all other institutions (the cross-sectional portion of the data). Data from each of the institutions for an eleven year period yield a total of 66 observations.

While it may seem extremely straightforward to simply write down cost and enrollment figures, such is not the case, as we wished our analysis to provide information on any additional burdens borne by the state of South Dakota as a result of increased enrollments of nonresident students. To accomplish this, only those expenditures which are funded by the state (largely through the tuition money) were relevant. In the HEGIS documents that expenditure account, which is primarily (over 90 percent) funded by the state and which is expected to be intimately connected with the level of undergraduate enrollment, is the account for instruction. This is not to say other accounts have no state money in them, as the academic support and student service accounts are 50 to 70 percent funded by state monies. Significant portions of these accounts are not expected to vary that closely with undergraduate enrollment, e.g., library expenditures, expenditures for museums and the like. In addition, the instructional account is by far the largest, typically accounting for almost 70 percent of the sum of expenditures from these three accounts.

There were some accounting anomalies which surfaced when the data were analyzed, such anomalies consisting primarily of some

expenditures appearing in one of the three accounts for some period of time, and then appearing in another. While more than one method of handling such anomalies exist, we summed the three accounts, then calculated the average ratio of the instruction expenditures to the total, which was 67 percent. An "adjusted" instruction variable was then constructed by multiplying the sum of the three accounts by the 67 percent. This had the desirable effect of smoothing out the more obvious kinks in the data while not affecting the statistical calculation of marginal cost much.

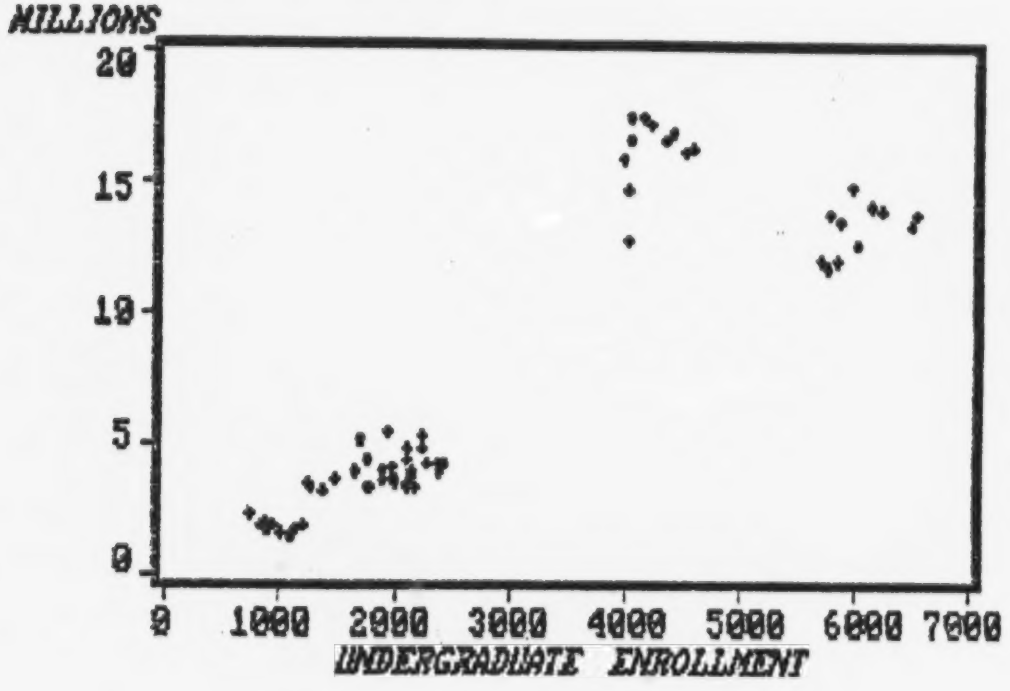
B. A Preliminary Glance at the Data

Figure 37 provides an interesting and useful preliminary look at the cost and enrollment data, with all the cost data being in terms of 1985 dollars. The horizontal axis measures undergraduate enrollment, as that is the type of enrollment which is of major concern. Each point, or dot, in the figure represents a certain real expenditure and undergraduate enrollment level. To construct this figure from the actual data, the information was grouped by size of school, moving from the smallest to the largest as we move from left to right on the horizontal scale.[16] Simple inspection suggests rather strongly that a positive relationship between undergraduate enrollment and costs exists, since as such enrollment increases,

[16] The schools in ascending order of undergraduate enrollment are, DSC, SDMT, BHSC, NSC, USD, and SDSU.

expenditures tend to do the same. The relationship appears to be far from perfect, however, as it is clear that there will be some variance around a statistically estimated line.

FIGURE 37: ADJUSTED INSTRUCTIONAL EXPENSE VS. UNDERGRADUATE ENROLLMENT
(1985 Dollars)



Close inspection also reveals that while the general tendency is clearly for costs to increase as undergraduate enrollment increases, the relationship does not seem to hold within an institution. Figures 38 through 43 illustrate this, as the instructional expenditures for each school are plotted against their undergraduate enrollment. Clearly for all schools, with the possible exception of SDMT, the positive

relationship between cost and undergraduate enrollment is weak, at best. In preparation for analysis of this phenomenon, as well as for an econometric evaluation of marginal costs, our next section describes a few of the relevant economic principles of cost.

FIGURE 38: INSTRUCTIONAL EXPENSE VS. UNDERGRADUATE ENROLLMENT AT DAKOTA STATE COLLEGE
(1985 Dollars)

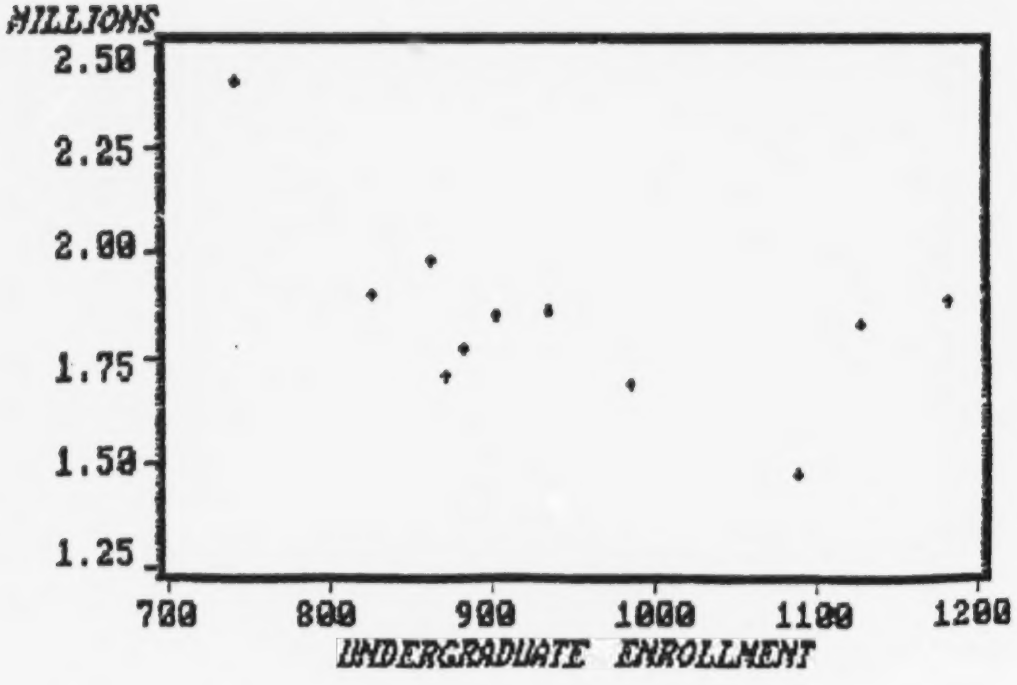


FIGURE 39: INSTRUCTIONAL EXPENSE VS. UNDERGRADUATE ENROLLMENT AT SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY (1985 Dollars)

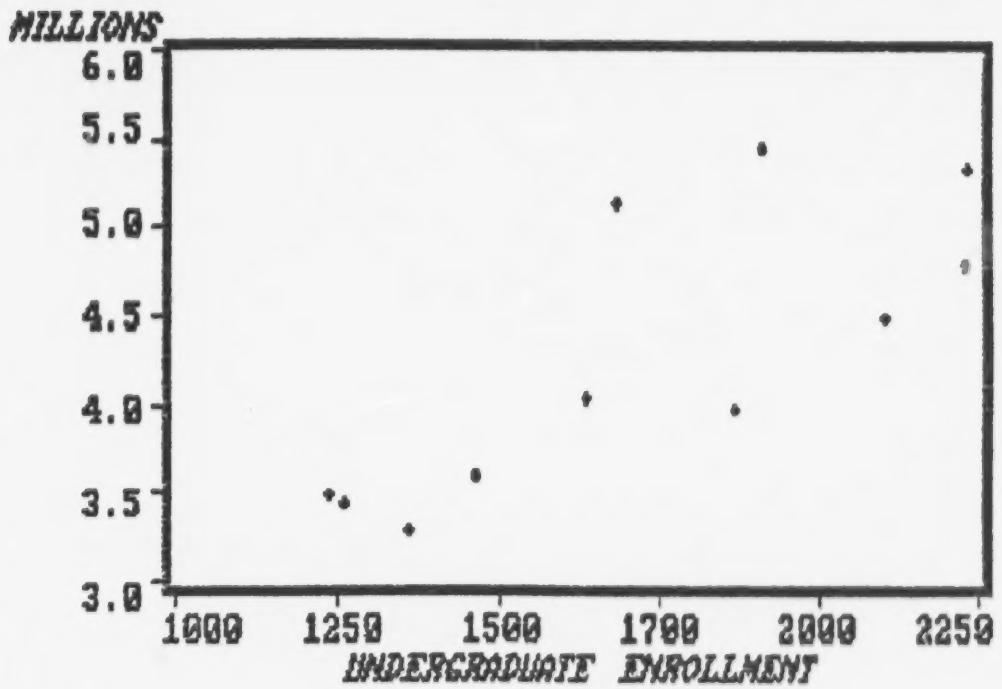


FIGURE 40: INSTRUCTIONAL EXPENSE VS. UNDERGRADUATE ENROLLMENT AT BLACK HILLS STATE COLLEGE (1985 Dollars)

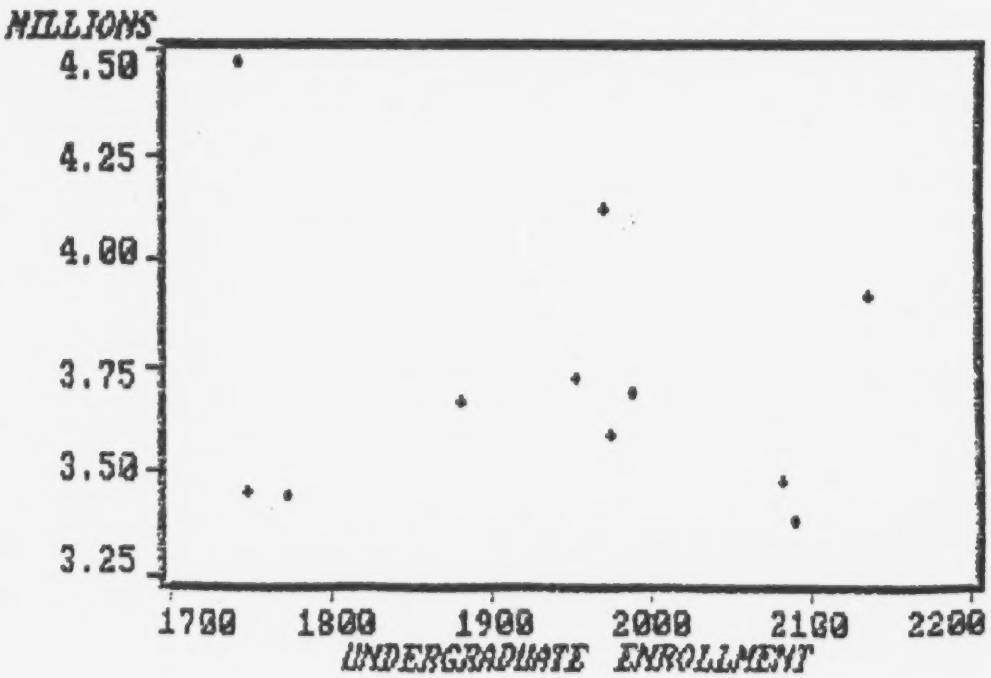


FIGURE 41: INSTRUCTIONAL EXPENSE VS. UNDERGRADUATE ENROLLMENT AT NORTHERN STATE COLLEGE (1985 Dollars)

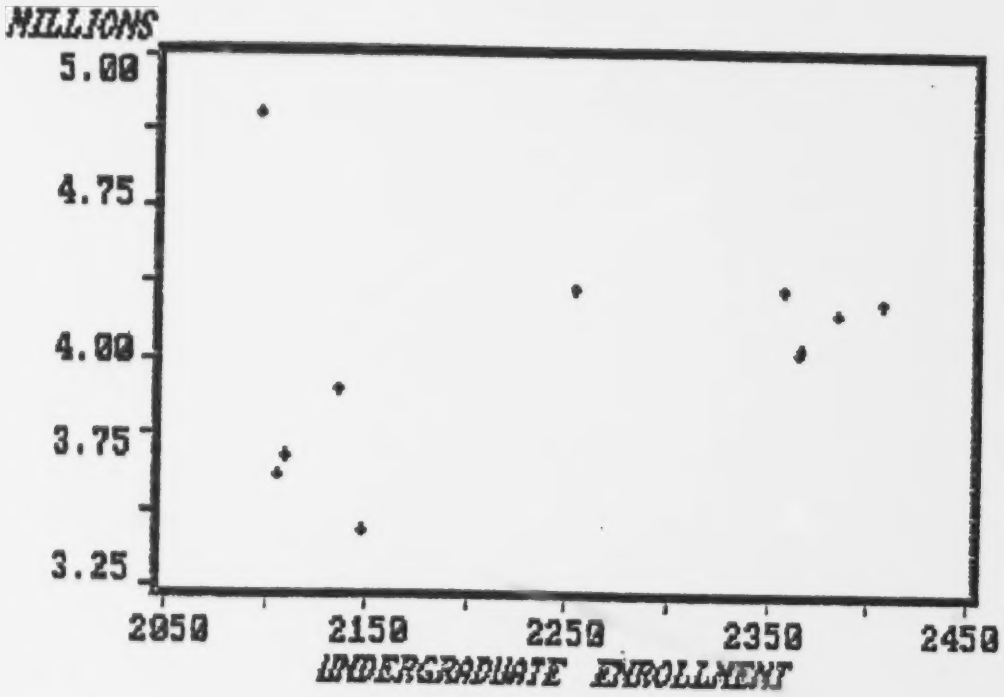


FIGURE 42: INSTRUCTIONAL EXPENSE VS. UNDERGRADUATE ENROLLMENT AT UNIVERSITY OF SOUTH DAKOTA (1985 Dollars)

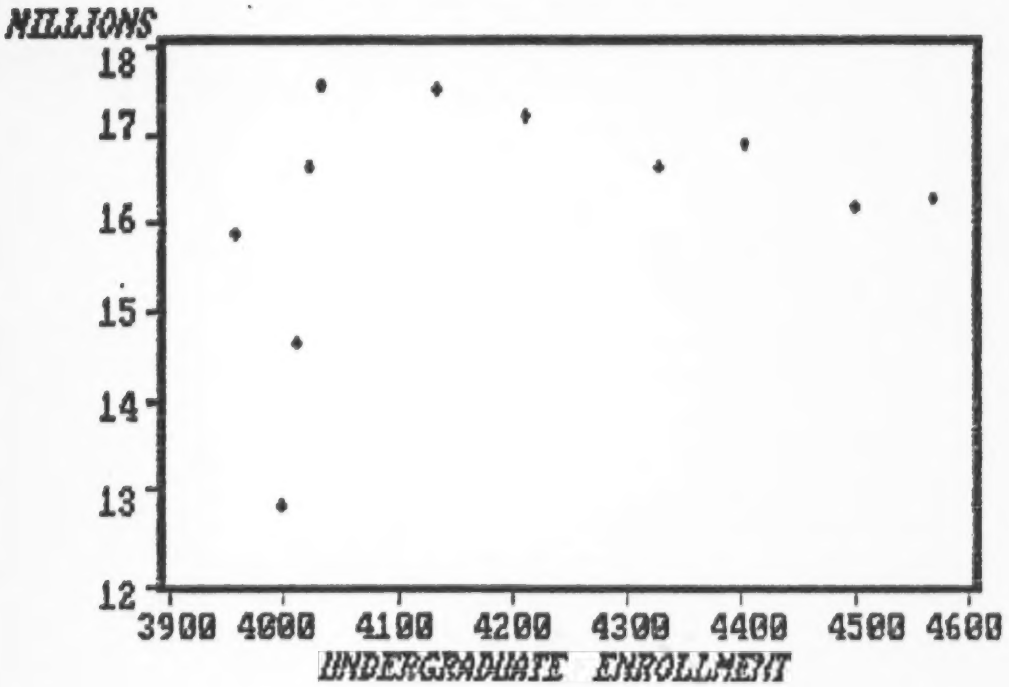
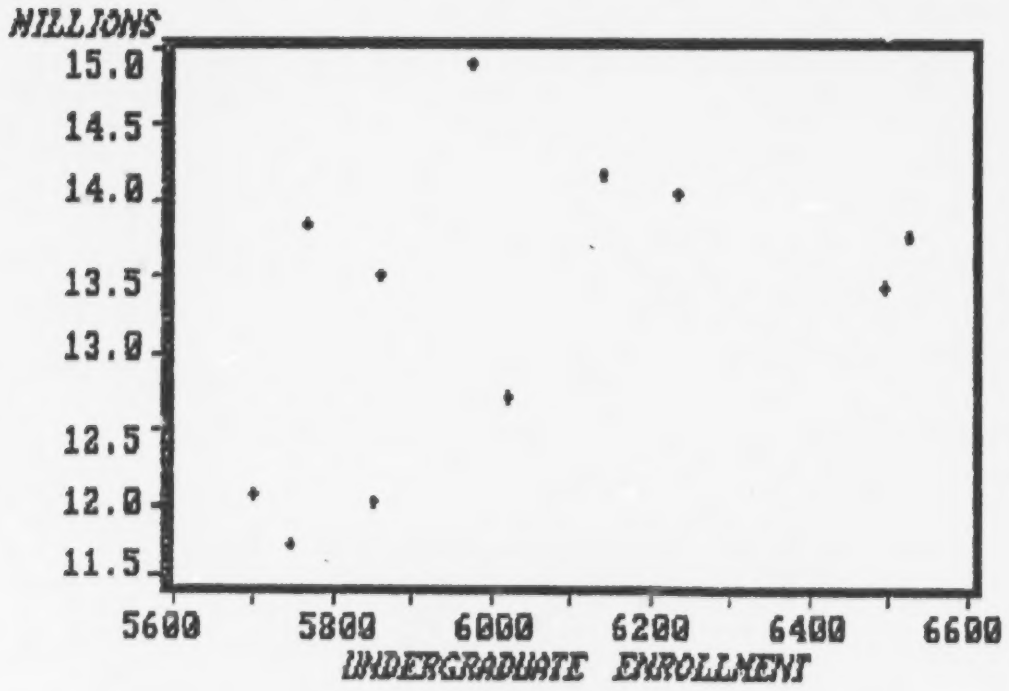


FIGURE 43: INSTRUCTIONAL EXPENSE VS. UNDERGRADUATE ENROLLMENT AT SOUTH DAKOTA STATE UNIVERSITY (1985 Dollars)



C. Description of Economic Principles

Elementary analysis shows that any relationship between cost and output depends on the goals of the institution being studied, as the goals being pursued affect behavior, and this affects the relationship between cost and output. For example, if the entity is a profit-maximizer, then the total cost of operation will be minimized at any given level of output. This yields a unique relationship between cost and output, and makes trenchant analysis possible. If no behavioral assumption concerning the institution can be made, then it is not logically possible to derive theorems about the cost function.

Public institutions of higher learning may, we suggest, be described as institutions that try to maximize output with a given budget constraint. This formulation recognizes that the total dollars a college or university has to spend is determined by the legislature. But it also recognizes that the institutions do the best they can with the dollars they have, i.e., they maximize output, with due concern for the quality of the product of the institution. Such behavior can be described in a variety of ways, but we choose the constrained output-maximizer for simplicity of exposition as well as descriptive accuracy.

While we believe the characterization of institutions of higher education institutions in South Dakota as constrained output-maximizers is useful, as it permits logical deduction of

testable theorems about the behavior of cost, it is crucial for intelligent analysis to recognize the existence of variables other than expenditures and the quantity of output. One such variable is perhaps best described by the term "product characteristics."[17]

Product characteristics become important in cost analysis if different output levels are achieved at the same cost, or, conversely, if the same output level is achieved at different expenditure levels. Economic principles suggest that if either of these phenomena is observed, then either production is occurring inefficiently at some levels of output or the characteristics of the product vary with output levels. In the context of higher education differing product characteristics are not easily observed, but we suggest that it is likely that there is some variance in the product which emerges from a particular institution. The average graduate in some years is of greater excellence than is the average graduate in other years, a fact which few of those intimately involved in higher education would care to dispute. It is also clear, however, that such variance has its limits. No one graduates without at least a gradepoint of 2.0, and to achieve such a grade point requires the acquisition of certain minimum of skill. Explicit recognition of such facts will play an important part in explaining the observed phenomenon of a strong enrollment cost relationship among

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[17] A more familiar term is "quality" of the product, but this is so value-laden that we opted for the more neutral "product characteristics" expression.

schools, but a weak relationship within schools.

If institutions of higher learning can be described in this way, then something cogent can be said about the nature of the cost function. Of special importance in the current context are the following mathematically derivable and empirically testable theorems: 1) the magnitude of cost will depend on the level of output and the prices of all inputs used in the production process, 2) total cost will increase as output expands, 3) increases in the prices of inputs will tend to increase costs except in the case where inferior inputs are used, and 4) insofar as improvement in the quality of the output depends on the quantity of inputs, a high quality product will cost more than a low quality one. Various other relationships can also be derived, e.g., the cost function must be homogenous of degree one in the prices of all inputs, but such considerations are of limited interest here.

D. Cost Relationships Within Vis a Vis Among Institutions

Brief as the above discussion of economic principles is, it is now possible to address the apparent anomaly of a positive relationship between cost and output holding when all the data are pooled together, and there being no such relationship within a particular institution. We suggest there are three primary reasons for this phenomenon. First, the variance of undergraduate enrollment within an institution over the time

period for which we have data is small. Second, significant changes in undergraduate enrollment were not permanent. Third, since our analysis was unable to capture changes in the characteristics of the product, a portion of the relationship between enrollment and cost may have been masked. Consider again the problem before us. We have a situation where a particular institution experiences enrollment changes, but does not experience changes in expenditures for instruction which correlate with the fluctuating enrollment. How could this be?

Only two general and credible approaches are open to us. First, we could abandon the assumption of the institutions being constrained output-maximizers, claiming instead that constant expenditures and varying enrollment implies the institutions are inefficient at low enrollment levels. Lacking a plausible alternative, abandoning the output-maximizing assumption means to surrender all hope of cogent analysis, and this we are understandably reluctant to do. The second general approach is to suggest that when enrollment varies and cost does not (or vice versa) some left-out variable explains the failure of cost to respond to enrollment. If we retain the assumption of cost-minimizing behavior, then surely if enrollment changes and expenditures do not <u>something</u> else must change, e.g., class size, the time in individual attention each student gets, and so on. As suggested in the section describing economic principles, we lump all such changes under the phrase, "changes in product characteristics," and proceed to reason as follows.

We suggest that small, nonpermanent changes in enrollment may engender small changes in product characteristics rather than small changes in expenditure. Small changes in class size will result in product characteristic changes that, although real, are difficult to perceive. However, large changes in class size will result in unacceptable changes in product characteristics, and the effort to restore or retain desirable characteristics results in either increased appropriations or a cap on enrollments. Hence we believe that if enrollment changes are small, then it is more likely that class size, etc. will adjust rather than expenditures. This would explain the lack of a strong relationship between expenditures and enrollment <u>within</u> an institution if the institution, in fact, experienced only small enrollment changes. It would also explain why a relationship does exist in the cross sectional data, where enrollment changes are much larger.

In like manner, if enrollment changes are expected to be of short duration, the institution may make less than a complete adjustment to such changes. That is, it may be the case, especially in times of stringent budgets, for institutions to permit a <u>short term</u> bulge in, for example, class size, even permitting a perceptible decline in the quality of instruction, if it is believed that this bulge will be of short duration. The shorter the duration of the bulge, the fewer the adjustments that will be deemed necessary.

In contrast to the behavior which occurs when change in

enrollment is small and temporary, large and permanent change will result in adjustments in expenditures which will permit the institution to carry out its mission. A failure to make such expenditure adjustments will change the product to an extent that is unacceptable, implying that in the long run enrollment will be an important determinant of costs. Accordingly, we believe that the posited relationship between cost and enrollment will exist within an institution as well as between institutions if large and/or permanent changes in enrollment occur.

We measured the extent of the variation in student enrollment for each school for the years 1975 through 1985 by taking the ratio of the standard deviation in enrollment to the mean enrollment over the period. We also ran simple correlations between real instructional expenditures and undergraduate enrollment. In addition, we suggest that the permanence of changes in enrollment within a period is indicated by the ratio of enrollment at the end of the period to enrollment at the beginning, and also by the trend of enrollment at the end of the period. If the level of enrollment at the end of the period is near the beginning figure, then no changes within the period can be regarded as permanent. In addition, if the trend at the end of the period is moving enrollment back towards the beginning level, changes within the period are regarded as less permanent than otherwise. The results of these calculations are depicted in Table 3.

Clearly the student enrollment for any school, with the

possible exception of SDMT, experienced a substantial degree of variation in enrollment, with all other schools save DSC having a ratio of less than 10 percent. SDMT had the highest ratio of approximately 21 percent, which is 50 percent higher than the next highest percentage, and four times higher than the ratios of the three largest schools. SDMT also experienced by far the greatest amount of growth, as measured by the ratio of ending to beginning enrollment. The current trend of enrollment at SDMT, however, is downward. Given the large variation in enrollment at SDMT, and the hint of permanence suggested by the high ratio of ending to beginning enrollment, it is reasonable to predict that SDMT is perhaps the best candidate for showing a positive relationship between undergraduate enrollment and cost. This prediction is borne out by the sign of the correlation coefficient, as SDMT has the correct sign for this statistic and in addition has by far the largest correlation coefficient between instructional expenditures and undergraduate enrollment. We interpret this as clearly supporting the proposition that variations in enrollment which are neither large nor permanent will result in only seemingly random variation in cost.

Finally, it should be pointed out for our readers that the addition of variables, along with undergraduate enrollment which we were able to measure and which are expected to influence costs, did not result in a significant statistical relationship between cost and undergraduate enrollment within institutions. We believe this adds further credence to our explanation. We turn

now to a careful analysis of the pooled data and to the estimation of the long run marginal cost.

TABLE 3

ENROLLMENT COST RELATIONSHIPS

School	Ratio of Std. Dev. to Mean	Simple Correlation Enrollment & Cost	Measure of Permanence Trend	Growth
DSC	14.4%	-.54	neg.	(.16)
SDMT	21.0%	.78	neg.	.36
BHSC	7.1%	-.19	-	.14
NSC	5.7%	.27	-	.13
USD	5.2%	.28	neg.	.01
SDSU	5.0%	.45	neg.	.04

* The negative indicator shows that the trend is back toward the enrollment level at the beginning of the period, suggesting that changes within the period were nonpermanent.

VI. ECONOMETRIC ESTIMATION OF THE COST FUNCTION

As indicated in a previous section, expenditures can be shown to depend on how much of the product of a given quality is produced, and how much must be paid to acquire the resources used in the production process. Our measure of output, we recall, is the number of undergraduate as well as the number of graduate students enrolled. We now define our measure of the price of resources as the compensation which must be paid to acquire teaching and research staff. Such a measure serves as a proxy for all resources used in the educational process. The Hegis reports provided this information for all public institutions of higher learning in South Dakota for the years 1975 through 1985. We are thus able to write the general expression:

(1) KRINST = f(UG2, GS2, RCOMP)

where KRINST is real adjusted instructional expenditure, UG2 is the number of undergraduate students enrolled, GS2 is the number of graduate students enrolled, and RCOMP is the annual real compensation of teaching and research at the various institutions.

The statistical formulation used to estimate the relationship between undergraduate enrollment and the cost of operating an institution was the simple linear relationship:

(2) $KRINST = B_0 + B_1\ UG2 + B_2\ GS2 + B_3\ RCOMP$

where the B's are the regression coefficients. The RCOMP coefficient was not statistically different from zero in this formulation, so it was dropped. The regression results are shown in Figure 44.

FIGURE 44: REGRESSION OUTPUT FOR REAL INSTRUCTIONAL COST

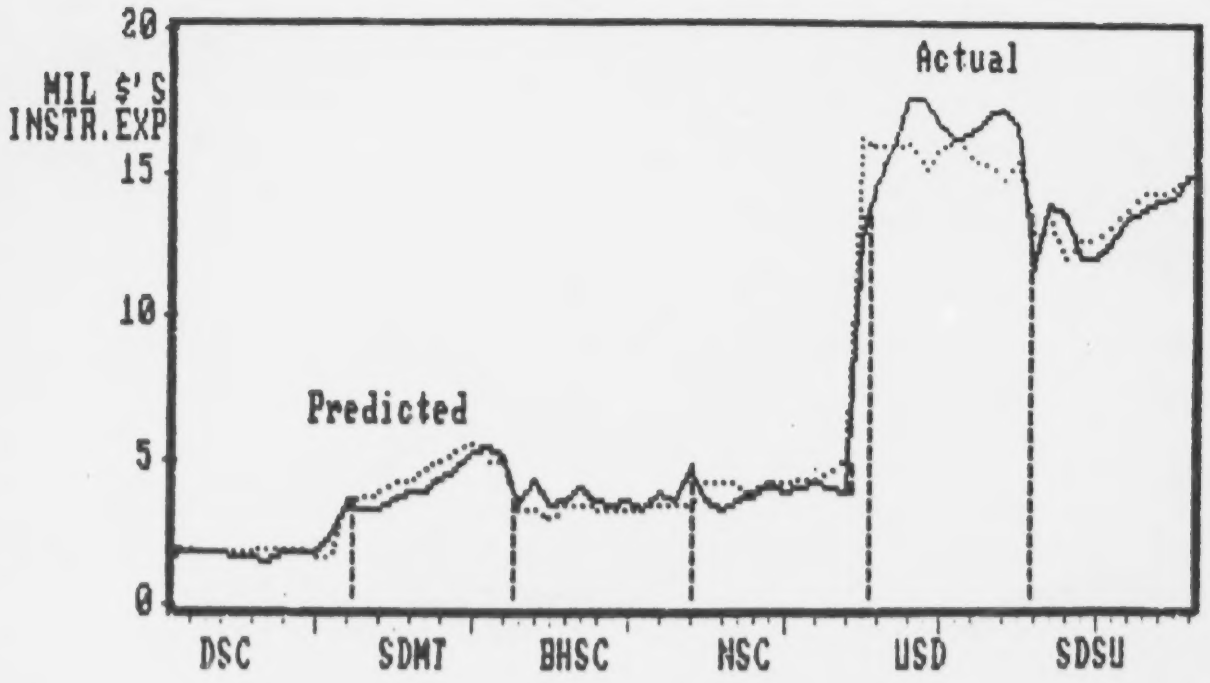
// Dependent Variable is KRINST
SMPL range: 1 - 66
Number of observations: 66

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	304818.22	197501.26	1.5433735	0.128
UG2	1518.7658	76.537821	19.843337	0.000
GS2	7030.0900	282.74990	24.863281	0.000

R-squared	0.978534	Mean of dependent var	7229427.
Adjusted R-squared	0.977852	S.D. of dependent var	5536298.
S.E. of regression	823921.7	Sum of squared resid	4.28D+13
Durbin-Watson stat	0.883171	F-statistic	1435.906
Log likelihood	-991.1556		

The explanatory power of this equation is quite high, as almost 98 percent of the variance in cost is explained and the t values on each variable are very large as well. A good idea of the closeness of fit can be gotten by inspecting the Figure 45, where the predicted expenditures are plotted against the actual expenditures of the six colleges for the years 1975 through 1985. Clearly our estimated equation predicts very well over the period for which we have data.

FIGURE 45: PREDICTED VS. ACTUAL INSTRUCTIONAL EXPENDITURES



The marginal cost of undergraduate education, holding everything else constant, is the coefficient of the undergraduate variable which is $1,519. This magnitude represents the total additional amount spent in the long run on instruction as a result of one more student attending a public institution of higher learning in the state of South Dakota. This magnitude has a certain plausibility to it, as it is easy to run a very rough, "back of the envelope" calculation for corroborative purposes. The average class size at public institutions of higher learning in South Dakota varies between 18 and 21 students per professor. The average real compensation including fringe benefits, of instructional staff was almost $31,000 in 1985. Dividing $31,000

by the average class size (19) yields $1,631, a number which closely approximates our estimated figure.

The output elasticity of cost yields some insight into the nature of the cost function. Calculated at the mean undergraduate enrollment level of 2,846 and the mean total real instructional expenditures (measured in 1985 dollars) of $7.229 million, the cost elasticity is 0.60. This means that if undergraduate enrollment increases by 10 percent, then instructional expenditures will in the long run increase by 6 percent. We therefore know that marginal cost is less than average cost, and that per unit cost will decline as output expands.

While we believe the instructional expenditures are those which will most directly measure the variance in state expenditures caused by changes in enrollment, there will also be some response in the other accounts as well, especially the academic support and student service account. We therefore ran the regression against the sum of the institutional, academic support, and student services accounts, the results of which are reported in the Figure 46. The marginal cost of undergraduate enrollment rises to $2,250, about $700 greater than when instruction alone is considered. Since only 50 to 70 percent of these accounts are funded with state money, the cost of an additional undergraduate student to the state is less than the $2,250. Conversely, the increased burden is probably somewhat more than the $1,519 instructional marginal cost. The cost

elasticity of the sum of three types of expenditure, calculated at the means, is again approximately 0.60.

FIGURE 46: REGRESSION OUTPUT FOR REAL INSTRUCTIONAL, SUPPORT, AND STUDENT SERVICES

LS // Dependent Variable is RST2
SMPL range: 1 - 66
Number of observations: 66

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	451582.58	292594.45	1.5433737	0.128
UG2	2250.0233	113.38936	19.843338	0.000
GS2	10414.948	418.88872	24.863282	0.000

R-squared	0.978534	Mean of dependent var	10710262
Adjusted R-squared	0.977852	S.D. of dependent var	8201922.
S.E. of regression	1220625.	Sum of squared resid	9.39D+13
Durbin-Watson stat	0.883171	F-statistic	1435.906
Log likelihood	-1017.096		

While the above formulation has a certain attractive simplicity, it is less than completely satisfactory, as prices of inputs play no role in the determination of cost, and marginal cost is constant, regardless of the number of graduate and undergraduate students. This being the case, it is not possible, with this formulation, to distinguish between the marginal cost of one school and that of another. While this question has great implicit interest, for the purposes at hand, the question is probably of limited importance, as the policy under consideration is one which concerns the entire state, not just individual schools. In addition, we believe great differences in marginal cost among the schools do not exist, as briefly discussed below.

We wish to stress that only very limited insight into this question is possible. More sophisticated formulations of the cost function, e.g., the translog function, succumbed to intractable problems of multicollinearity. Experimentation with different varieties of dummy variables, both intercept and slope, resulted in great instability of the coefficients, and hence widely varying estimates of marginal cost. Notwithstanding the above difficulties, some insight into the question may be gotten by rerunning the basic linear equation, omitting a particular school, and seeing what the impact of this omission is on the calculation of marginal cost. If for example, omitting the University of South Dakota from the data set results in an increase in the marginal cost for the remaining schools, then the marginal cost at the University is lower than at least some of the other schools. We ran the regression six additional times, omitting a different school on each of the runs. The results are set forth in the Table 4.

Even casual inspection suggests the great stability of the coefficients under this formulation, in that leaving one school out of the calculation has very little effect on the magnitude of marginal cost. This is suggestive that substantial differences in marginal cost among the schools do not exist.

TABLE 4

PROXIMITY OF MARGINAL COSTS AMONG SCHOOLS

School	All School Marginal Cost With One School Omitted	Effect of Omission on All Sch. MC
DSC	$1,539	$20
SDMT	1,517	($2)
BHSC	1,523	$4
NSC	1,515	($4)
USD	1,666	$147
SDSU	1,333	($186)
Average of All Schools	$1,519	-

In summary, the cost data shows that marginal instructional cost is in the neighborhood of $1,500, and that marginal cost of instruction, academic support, and student services is a little over $2,000. The next step is to compare this cost with the extra revenues which can be expected if additional enrollment is induced through a reduction in tuition for nonresident students.

VII. DEMAND AND COST TOGETHER

In the previous sections we provided estimates of both the demand and cost side of nonresident undergraduate enrollment in South Dakota public institutions of higher education. The demand estimates indicated that nonresident enrollment is remarkably

responsive (elastic) to changes in the price. The analysis has also shown that at reasonable price elasticities (-1.0 to -2.75) the marginal revenue from enrolling each additional nonresident student ranges from $0 to $1,415 depending on the price elasticity[18] estimate and the nonresident tuition rate.

The cost estimates indicate that the marginal instructional cost of each additional student tends to fall in the area of $1,500 per each additional student.[19] Even casual investigation of the data indicates that marginal cost is greater than marginal revenue. It seems clear, then, that attracting more nonresident students by the policy of reducing price will increase costs by more than it increases revenues.

An example may be useful. Assume an average price elasticity of -2.0, the beginning level of nonresident students is 1,000 students, the initial nonresident tuition rate is $69.50 per credit hour, and the average full year academic load is 32 credit hours. That would generate $2,224,000 (1,000 students X $69.50 per credit hour X 32 credit hours) in revenue. Now assume that the nonresident tuition rate was reduced to $59.50 per credit. This 14.4 percent price reduction would be expected to increase enrollment by 288 (-14.4 percent X -2.0 X 1000) students (over the long-run). Consequently, revenues would now be $2,452,352 (1,288 students X $59.50 per credit hour X 32 credit hours) or

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[18] At a price elasticity of -1.0 the marginal revenue would be $0 and at -2.75 it would be $1,415.

[19] The marginal cost of instruction, academic support, and student services is approximately $2,200.

$228,352 more than before the nonresident tuition reduction. This would amount to $1,001.50 ($228,352/228 students) per additional student. If the marginal cost is in the area of $1,500 per student, this would mean a net loss of approximately $500 per student.

VIII. COMMUNITY EFFECTS OF INCREASED ENROLLMENT

THE ECONOMIC IMPACT OF STUDENTS IN HIGHER EDUCATION

The purpose of this section of the study is to briefly examine the economic impact of students on their local college environment. Several South Dakota colleges and universities have conducted economic impact studies to determine how the institutions and their members contribute to the local economy. These studies have examined many facets of the economy that are affected by the existence of these institutions. However, in this study, one of the primary concerns is estimating how many dollars an additional student would spend in the local economy and how this spending would contribute to the state and local tax base.[20] The importance of the college student to many of these cities is indicated in Table 5.

From the five economic impact studies, an estimate of the average monthly expenditure per student was derived. These estimates indicate what an on-campus student spent in their local

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[20] For more information, see William H. Bergman, Economic Impacts of Higher Education in South Dakota, Business Research Bureau, University of South Dakota, 1981.

TABLE 5

STUDENT ENROLLMENT VS. CITY POPULATION

CITY	1984 STUDENT POPULATION	1984 CITY POPULATION	STUDENT/CITY POPULATION RATIO
SPEARFISH	2,296	5,710	40%
RAPID CITY	2,583	49,146	5%
VERMILLION	5,758	10,007	58%
ABERDEEN	2,718	25,746	11%
BROOKINGS	6,940	15,028	46%
MADISON	977	6,349	15%

environment exclusive of tuition, room, and board, in 1985 dollars. These include expenditures for food, entertainment, clothing, etc. The highest monthly expenditure amounts per student were reported from Northern State College, the University of South Dakota and the South Dakota School of Mines with $216, $215, and $200, respectively. The lowest on-campus student expenditure of $75 per month was reported from Black Hills State College located in Spearfish. The economic impact study performed at the former University of South Dakota campus in Springfield indicates that a student would contribute $131 per month. Since student expenditure amounts were not available from Dakota State College and South Dakota State University, an average of the expenditure amounts computed from the other studies was computed and used. For SDSU in Brookings S.D., the on-campus student expenditure amount was calculated by averaging the student expenditures form the three largest populated cities

that have a state supported higher education institution. The student expenditure amount for DSC in Madison was calculated by averaging the total monthly expenditure of students on the campus of BHSC and the former USD/S. Table 6 presents expenditures per student by school in 1985 dollars.

The dollar amount of state and municipal sales taxes that would be contributed by an additional student in 1985 dollars is shown in Table 7. The South Dakota state sales tax rate is 4 percent. An additional 1 percent to 2.5 percent is charged by each city for the support of local governmental services. As shown in Table 7, the nine month average expenditure (excluding sales taxes) per student ranged from $636.79 to $1,825.47. The average annual contribution to state and local sales taxes ranged from $38.21 to $99.53.

TABLE 6

AVERAGE EXPENDITURES BY AN ON-CAMPUS STUDENT
EXCLUSIVE OF TUITION, ROOM AND BOARD
(In 1985 Dollars)

INSTITUTION	CITY	1984 POPULATION PER STUDENT	MONTHLY EXPENDITURE PER STUDENT	9-MONTH EXPENDITURE
BHSC	SPEARFISH	5,710	$75.00	$675.00
USD/S	SPRINGFIELD	1,340	$131.00	$1,179.00
SDMT	RAPID CITY	49,146	$200.00	$1,800.00
USD	VERMILLION	10,007	$215.00	$1,935.00
NSC	ABERDEEN	25,746	$216.00	$1,944.00
SDSU	BROOKINGS	15,028	$210.00	$1,890.00
DSC	MADISON	6,349	$103.00	$927.00

At this point, the spending estimates include only direct

spending and do not include the additional spending induced by this spending. Economic theory implies that direct spending is subject to a multiplier effect commonly referred to as the expenditure multiplier. For example, when individuals spend their income at a local business, the income received by the business is used to pay its employees and replace the inventory for later sales. A fraction of this money will be spent locally which generates an additional round of spending. The successive rounds of spending determine the multiplier impact. Input-Output estimates by state and industry are computed by the Bureau of Economic Analysis of the U.S. Department of Commerce. A student spending multiplier of 1.92 was calculated by averaging the multiplier for South Dakota retail trade and eating and drinking

TABLE 7

ESTIMATED STATE AND MUNICIPAL SALES TAXES
GENERATED FROM SPENDING BY STUDENT A RESIDING ON-CAMPUS
(In 1985 Dollars)

CITY	9-MONTH TOTAL EXPENDITURE (Tax excl.)	STATE SALES TAX AT 4%	MUNICIPAL SALES TAXES 1%	2%	2.5%
SPEARFISH	$636.79	$25.47	---	$12.74	---
RAPID CITY	$1,690.14	$67.61	---	---	$42.25
VERMILLION	$1,825.47	$73.02	---	$36.51	---
ABERDEEN	$1,825.35	$73.01	---	---	$45.63
BROOKINGS	$1,783.02	$71.32	---	$35.66	---
MADISON	$882.86	$35.31	$8.83	---	---

establishments.[21] This states that for each dollar spent by a student induces $.92 in additional spending. Table 8 shows the effect of this additional economic activity created by student spending during a nine month period. The last column in Table 8 shows the total impact of student spending. As presented in Table 8, the total spending estimates per student per year range from $1,296 to $3,732.

TABLE 8

STUDENT SPENDING MULTIPLIER EFFECT
(In 1985 dollars)

INSTITUTION	CITY	9-MONTH DIRECT SPENDING TOTAL	ESTIMATED STUDENT SPENDING MULTIPLIER	STUDENT SPENDING PER 9-MONTH
BHSC	SPEARFISH	$675	1.92	$1,296.00
SDMT	RAPID CITY	$1,800	1.92	$3,456.00
USD	VERMILLION	$1,935	1.92	$3,715.20
NSC	ABERDEEN	$1,944	1.92	$3,732.48
SDSU	BROOKINGS	$1,890	1.92	$3,628.80
DSC	MADISON	$927	1.92	$1,779.84

[21] Estimates were taken from U.S. Department of Commerce, Regional Multipliers: A User Handbook for Regional Input-Output Modeling System, Bureau of Economic Analysis, (Washington D.C.: U.S. Government Printing Office, May 1986).

IX. SUMMARY AND CONCLUSIONS

A. Summary

The stated purpose of this study is to find answers to the followings three questions:

1. What is the likely response in terms of nonresident undergraduate enrollments to a lowering of nonresident tuition rates in South Dakota public institutions of higher education? Would the increased revenue from increased enrollments be sufficient to offset the lower revenues due to reduction in nonresident tuition charges?
2. What is the cost of educating additional nonresident students in South Dakota public institutions of higher education and is this cost more or less than the additional revenue generated by reducing the tuition rate to attract additional students?
3. What are the other economic benefits to the state's economy in terms of increased spending and tax revenues to be derived from a higher enrollment of nonresident students?

In our opinion we were successful in providing answers to each of these three questions. In terms of question 1, there is little question that nonresident enrollments are responsive to changes in the nonresident tuition rate charged by public institutions of higher education in South Dakota. We examined the

price[22] responsiveness of enrollment from Iowa, Minnesota, Nebraska, North Dakota, Wyoming, and all other states and foreign countries at each of the six public institutions of public higher education in South Dakota. We were able to isolate those states which were of greatest importance to each of the schools in South Dakota. A listing of the schools and the states for which price responsiveness was statistically significant is shown below.

School	States of Importance
USD	Iowa, Minnesota, and Nebraska
BHSC	North Dakota
DSC	Minnesota
NSC	Minnesota and North Dakota
SDMT	Minnesota, North Dakota, Nebraska, and All Other States and Foreign Countries
SDSU	Minnesota, Iowa, and All Other States and Foreign Countries

One surprise was the lack of price responsiveness for Wyoming students at either BHSC of SDMT.

In most cases the long-run price elasticity of enrollment

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[22] Price for the purposes of this study was defined as the ratio of nonresident tuition charges in South Dakota to the resident tuition charge in the state from which the student migrated. Consequently, the price can change due to a change in the South Dakota nonresident charge or a change in the resident tuition charge in the state in question.

demand was price elastic. This means that the percentage change in enrollment response was greater than the percentage price change. The significance of this is that total revenue increases when the nonresident tuition rate is reduced because the revenue gain from the additional students more than offsets the revenue loss from charging the existing students a lower rate.

After computing the price elasticity of enrollment demand we were able to calculate the marginal revenue attributable to each additional nonresident student. We found that at the 1985-86 nonresident tuition rate of $69.50 per credit hour, the marginal revenue from each additional nonresident student ranged generally from $0 to $1,415 depending on the price elasticity of demand.

Turning to the second question relating to the marginal costs of each additional nonresident student, we were able to compute marginal cost of increased undergraduate enrollment. The results of this analysis indicates that marginal instructional costs are approximately $1,500 and marginal cost of instruction, academic support, and student services summed are approximately $2,200.

Finally, to answer the third question we relied on previous studies of the spending impact of students in the college community. Based these studies we concluded that the direct and indirect spending impact in the local community ranged from $1,296 to $3,732 per student in 1985 dollars. The state and local sales tax revenue generated per student ranged from $73.36 to $210.30 per year.

B. Conclusions

So what do we conclude from this analysis? First, it appears, assuming reasonable elasticity estimates, that a reduction in the nonresident tuition rate would significantly increase enrollment. Second, assuming a marginal cost of at least $1,500 per student and a maximum marginal revenue of $1,415 per student[23] that cutting the nonresident tuition rate would not generate sufficient revenue to cover the additional cost.

Assuming that there is a desire to increase nonresident enrollment without being too costly to the state, what strategies could be followed? Here are a list of possible strategies that could be used.

1. Efforts could be made to increase the demand (shift the demand curve to the right) by more promotion efforts, which have the effect of informing nonresident students of the attractive relative costs of enrolling in South Dakota schools. For instance, for Iowa students the cost of attending school in South Dakota as a nonresident student is not much different than attending school in Iowa as a resident student. Better dissemination of this type of information might encourage greater enrollments from that state. This approach would allow South Dakota to increase nonresident enrollment without cutting the

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[23] This assumes a credit hour charge for nonresident students of $69.50 and a price elasticity of -2.75.

nonresident tuition rate.

2. It is possible to increase nonresident enrollment by means other than cutting the nonresident tuition rate, and this nonprice cutting strategy is that which we believe deserves careful consideration. Since the appropriate price variable for analysis purposes is a ratio, the ratio of nonresident tuition in South Dakota to the resident tuition charge in the state of origin, the price could be lowered by either reducing the nonresident tuition rate in South Dakota or allowing other states to raise their resident tuition rates over time. Therefore, one option would be to keep the nonresident tuition rate fairly constant, while other states raise their resident tuition rates. This effective lowering of the price would make South Dakota increasingly competitive over time. Since the nonresident tuition rate would not be changed the actual revenue generated by more students would be $2,224 ($69.50 X 32 hours) which is above the probable marginal costs. If the marginal costs do rise secularly, the nonresident tuition rate might be raised to keep in line with the marginal cost. Effectively, this policy amounts to setting the nonresident tuition rate at the marginal cost. The main advantage of this approach is that the revenue loss which occurs when nonresident tuition rates are cut is no longer a consideration.

3. Another strategy might be to reduce marginal cost by varying the student/faculty ratio through adjusting class size and/or requiring more preparations per professor. Also, the schools with graduate programs might make greater use of teaching assistants. Another related approach is to vary the teaching/research/service mix of the institution. Problems with these approaches include possible adverse impacts on the quality of education, as well as potential conflict with other goals of the educational institution.

4. An additional comment relates to the negotiation of tuition rates under reciprocity agreements. For example, when the South Dakota-Minnesota tuition reciprocity agreement was first started in 1978, South Dakota students attending schools in Minnesota paid the Minnesota resident tuition rate, and Minnesota students attending schools in South Dakota paid the South Dakota resident tuition rate. When the agreement was renegotiated in 1983, both South Dakota and Minnesota nonresident students paid the average of the South Dakota and Minnesota resident tuition rates. The effect of this renegotiation was to raise the price to Minnesotans enrolling in South Dakota and lower the price to South Dakotans enrolling in Minnesota. This change had both positive and negative effects. It tended

to hurt South Dakota enrollments but increase net revenues.[24] This hurt South Dakota enrollment in two ways. First, it encouraged more South Dakota students to enroll in Minnesota. Second, it discouraged Minnesota students from enrolling in South Dakota. Furthermore, if the price elasticity is elastic, as our research indicates it is, it had the effect of reducing revenue because the revenue lost from the fewer students was not offset by the higher revenue from the existing students. However, from a net revenue point-of-view, it probably increased net revenue because the marginal cost of educating an additional student is undoubtedly higher than the average of the two tuition rates. Therefore, the reduction in enrollment that was not covering the marginal costs increases net revenue.

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[24] Net revenue is defined as the difference between marginal revenue and marginal costs.

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